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ISSUE # 329

73 AMATEUR RADIO

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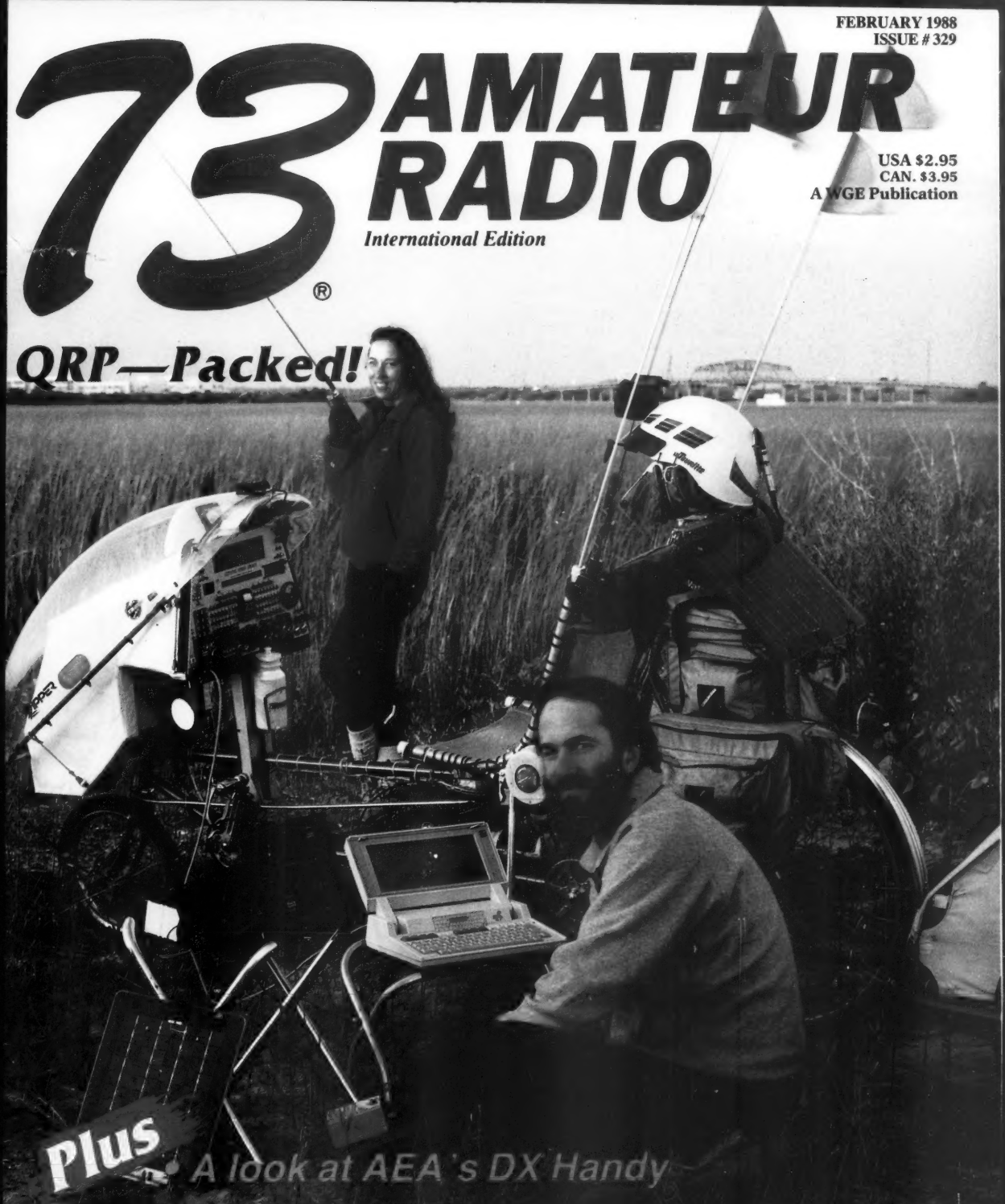
QRP—Packed!



Plus

- A look at AEA's DX Handy
- Five high tech, Low power projects
- License-free fun at 160kHz
- Helping the HW-9

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NEW

ICOM IC-900
Six Bands in One Mobile!

ICOM IC-900 FIBER OPTIC FM MOBILE

ICOM introduces the revolutionary IC-900 multi-band FM mobile transceiver. ICOM, first in utilizing fiber optic technology in amateur radio, enables you to create your own mobile communications system. Six band combinations... 10M FM, 6M, 2M, 220MHz, 440MHz, and 1.2GHz. It's the most advanced, versatile, compact, and easy-to-use mobile available.

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Remote Controller. Measuring only 2 inches high by 5.7 inches wide by 1 inch deep, the remote controller can be installed on your car's dash or sun visor with the supplied velcro. And, if you want, take the controller with you when you leave your car. The controller features a super large, highly visible LCD.

Interface Unit A is installed in a location near the driver's seat.

Interface Unit B controls the six band units and can be installed in your car's trunk. A **fiber optic** cable runs from Interface A to Interface B, which transports an abundance of information through a 3/16" cable and eliminates RF feedback.

Band Units are "stacked" onto the Interface B Unit via the supplied mounting bracket. Optional band units available are:

Band Unit	Power Output	Frequency
UX-19A	10W/1W	28-30MHz
UX-29A	25W/5W	138-174MHz Rx; 140.1-150MHz Tx
UX-29H	45W/5W	138-174MHz Rx; 140.1-150MHz Tx
UX-39A	25W/5W	216-236MHz Rx; 220-225MHz Tx
UX-49A	25W/5W	440-450MHz
UX-59A	10W/1W	50-54MHz
UX-129A	10W/1W	1240-1300MHz

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- **Receive incoming phone calls**

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- ✓ **Change frequencies from the controlling telephone**
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- ✓ **Eavesdrop the channel from any telephone**
- ✓ **Use as a wire remote using ordinary dial up lines and a speaker phone as a control head.**

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- • Timeout timer
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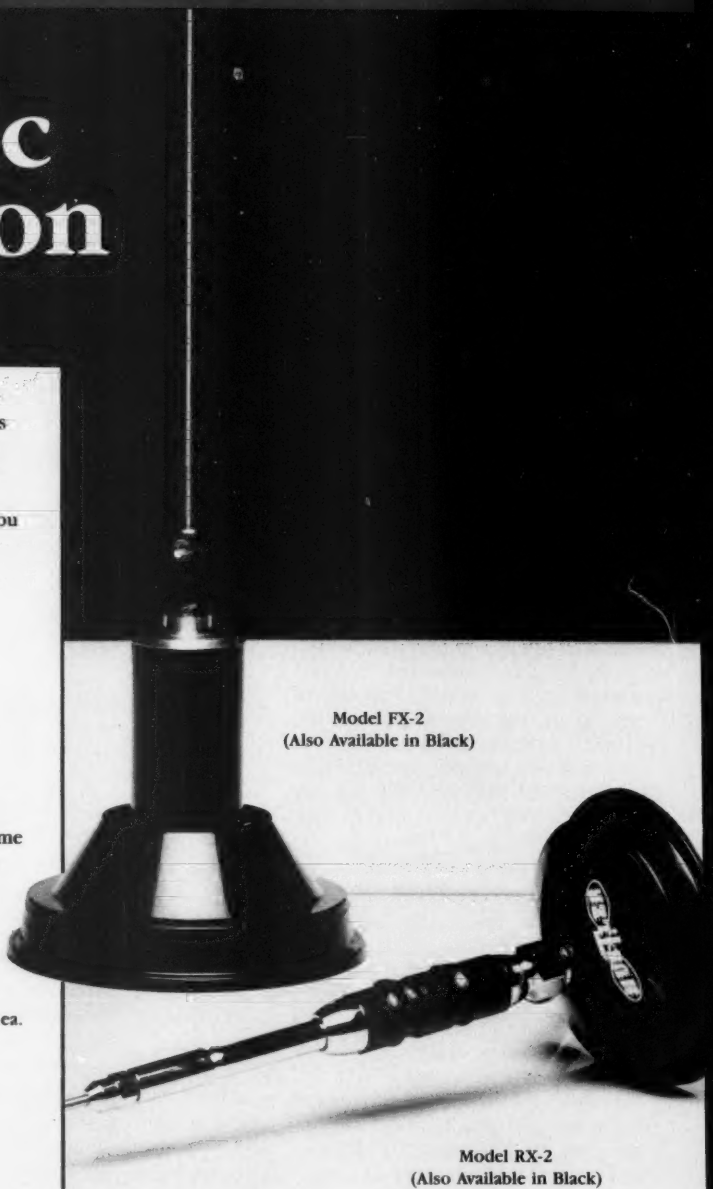

Model FX-2
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Plus you get high performance HF/VHF/CW modems, software selectable dual radio ports, precision tuning indicator, 32K RAM, AC power supply and more.

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Hardware DCD gives you more QSOs because you get reliable carrier detection under busy, noisy or weak conditions.

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You can copy all shifts and all standard speeds including 170, 425 and 800 Hz shifts and speeds from 45 to 300 baud. You can *copy not only amateur RTTY but also press, weather and other exciting traffic.*

A high performance modem lets you copy both mark and space for greatly improved copy under adverse conditions. It even tracks slightly drifting signals.

You can transmit both narrow and wide shifts. The wide shift is a standard 850 Hz shift with mark/space tones of 2125/2975 Hz. *This lets you operate MARS and standard VHF FM RTTY.*

You get both the American Western Union and the international CCITT character sets. Autostart for unattended reception and selectable "Diddle".

A receive Normal/Reverse software switch eliminates retuning and Unshift-On-Space reduces errors under poor receiving conditions.

ASCII

You can transmit and receive 7 bit ASCII using the same shifts and speeds as in the RTTY mode and using the same high performance modem. You also get Autostart and selectable "Diddle".

CW

You get a Super Morse Keyboard mode that lets you send perfect CW effortlessly from 5 to 99 WPM, including all prosigns -- it's tailor-made for traffic handlers.

A huge type ahead buffer lets you send smooth CW even if you "hunt and peck".

You can store entire QSOs in the message memories, if you wanted to! You can link and repeat any messages for automatic CQs and beaconing. Memories also work in RTTY and ASCII modes.

A tone Modulated CW mode turns your VHF FM rig into a CW transceiver for a new fun mode. It's perfect for transmitting code practice over VHF FM.

An AFSK CW mode lets you ID in CW.

The CW receive mode lets you copy from 1 to 99 WPM. Even with sloppy fists you'll be surprised at the copy you'll get with its powerful built-in software.

You also get a random code generator that'll help you copy CW faster.

Weather FAX

***You'll** be fascinated as you watch WEFAX signals blossom into full fledged weather maps on your printer.* Other interesting FAX pictures can also be printed -- such as some news photographs from wire services.

Any Epson graphics compatible printer will print a wealth of interesting pictures and maps.

Automatic sync and stop lets you set it and leave it for no hassle printing.

You can save FAX pictures and WEFAX maps to disk if your terminal program lets you save ASCII files to disk.

Pictures and maps can be *printed to screen in real time or from disk* on IBM and compatibles with the MFJ-1284 Starter Pack.

You can transmit FAX pictures right off disk and have fun exchanging and collecting them.

Slow Scan TV

The MFJ-1278 introduces you to the exciting world of slow scan TV.

You'll not only enjoy receiving pictures from thousands of SSTVers all-over-the-world but you can send your own pictures to them, too.

You can print slow scan TV pictures on any Epson graphics compatible printer. If you have an IBM PC or compatible you can print to screen in near real time or from disk with the MFJ-1284 Starter Pack.

You can transmit slow scan pictures right off disk -- there's no need to set up lights and a camera for a casual contact.

You can save slow scan pictures on disk from over-the-air QSOs if your terminal program lets you save ASCII files.

The MFJ-1278 transmits and receives 8.5, 12, 24, and 36 second black and white format SSTV pictures using two levels.

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***Nothing** beats the quick response of a memory keyer during a heated contest.*

You'll score valuable contest points by completing QSOs so fast you'll leave your competition behind. And you can snag rare DX by slipping in so quickly you'll catch everyone by surprise.

You get iambic operation with dot-dash memories, self-completing dots and dashes and jamproof spacing.

Message memories let you store contest RST, QTH, call, rig info -- everything you used to repeat over and over. You'll save precious time and work more QSOs.

You get automatic incrementing serial numbering. In a contest it can make the difference between winning and losing.

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Turn on your MFJ-1278 and it sets itself to match your computer baud rate. Select your operating mode and the correct modem is automatically selected.

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CIRCLE 24 ON READER SERVICE CARD

Welcome, Newcomers!

What is QRP?

Amateur radio lingo is full of abbreviations and code words, many of which have evolved from the days of CW (Morse code)-only communications. (Check the glossary for definitions of unfamiliar words printed in bold type below.)

A lot of common and relevant statements and questions have been reduced to three-letter statements/questions beginning with "Q." Many words and phrases have also been abbreviated into procedural signals, or prosigns. This made CW communications much more efficient. *Very* few of us can send CW at the rate (words per minute) that we can speak. See the December 1986 Newcomer's column for a more complete list of these signals.

Literally, QRP means "Reduce you power." Hams who enjoy low-power operation became known as QRPers. The unoffical maximum QRP power level is set at less than five or ten watts, depending on whom you ask. One watt or less of power out is called QRPp operation.

Many hams at first say, "What's the point in QRP operation?" Mayhem often reigns on the bands during periods of good **propagation**, with some hams running a **full gallon**-plus battling it out. "How can the little gun hope to compete?" "Why would anyone *want* to be a little gun? "

To be sure, there are reluctant QRPers—hams who make do with the equipment they have until they scrimp and save enough to run out and buy a 100-watt output rig or a **linear amp**. QRP has a large and devoted following, however. There's obviously much more to QRP than first meets the ear, as this issue will attempt to explain.

The Elegance of QRP

A QRP station can be very small—there are QRP transceivers that can fit in the palm of your hand! QRP can be much simpler devices than higher-powered rigs since there are fewer stages of circuits in the rig to step up the power of the signal and ensure the **linearity** and **purity** of its output signal. One- or two-afternoon QRP transceiver projects abound—Mike Bryce's QRP column is full of 'em. For hams who actually want to *apply* the electronic theory they learned (or memorized) for their exam, building a QRP rig is a great place to start—very little can match the thrill of making a DX contact on a piece of equipment that you've built yourself!

Now, you've built your pocket-sized, five watt rig on Friday night and Saturday and hanker to get on the air on Sunday. You know, however, that when propagation is good, the bands are often wall-to-wall booming signals.
What to do?

Craft Instead of Kilowatts

QRPers have to be a tenacious breed, but they soon learn that power out is not the only factor in making a contact. They bag many of their contacts when a particular band just **opens up**, before most other hams become aware of it. This doesn't mean that QRPers sit by their rigs 24 hours a day—band openings for many bands are predictable. A QRPer soon becomes skilled in the science of propagation.

The science is far from exact. There are unpredictable bands. Ten meters is often closed, especially during low sunspot activity, but can open up very suddenly at different times of the day. This band needs more monitoring, but then the chances are better that fewer people become aware of its opening, and the QRPer has a longer opportunity to work DX. When propagation is good, a *milliwatt* transmitter can still get a good report from a DX station. Read the DX Handy review by Mike Bryce and Chod Harris' DX column in this issue for more info on 10 meters.

A Little Antenna Math

A good high-gain antenna system greatly enhances the QRPer's chance of getting through to a contact.

What does **gain** mean? Gain is simply a *ratio*, usually expressed in decibels (dB), of a given antenna's effectiveness to direct signals toward or receive signals from a given direction. Gain measurements are made with respect to reference antennas, usually a theoretical **isotropic radiator**, a quarterwave vertical or a dipole. Gain is always measured with respect to *something* at a given frequency. A gain measurement made with respect to a dipole would have a "d" tacked on the end. A 6 dBd gain measurement indicates the antenna will improve signal strength in a given direction on a specific frequency four times (6 dB) over what a dipole would provide.

A high gain antenna is also very directive; that is, it tends to concentrate most of the radiation in a specific direction. Hence, antennas can increase the effective radiated power (ERP) of a transmitter. An antenna with 10 dBi maximum gain—the "i" shows the reference antenna is an isotrope—will generate a signal strength ten times greater at a receiver downrange from the main beam than an istoropic antenna using the same power. In other words, ten watts to a 10 dBi antenna will generate the same signal strength as 100 watts to the reference antenna; hence the term *effective* radiated power.

Can 100 watts ERP effectively compete with the rest of hamdom? You bet! Many hams live in areas that restrict antenna systems. A city lot may not provide enough space for more than simple dipoles or verticals. Most hams don't run more than 100 watts, because linear amplifiers are too pricey.

You can see a QRPer with a good antenna system is really in the running!

Hats Off to QRPers

The finest point of QRP operation is that its pursuit forces the ham to *think*. He has to experiment with his equipment—installing narrow filters, improving antennas—and learn about propagation. The QRPer avoids the all-too-easy solution of cranking up the power to get through the crowds, which very easily leads to crowding out others. He shows courtesy to his fellow hams by almost never running more power out than necessary to conduct a contact (which is, incidentally, an FCC rule!). This is what separates the QRPers, who practice two critical mandates of the hobby—that of advancing the state of the art and fraternal goodwill—from the emerging throng of operators who treat the linear amp as a cure-all.

Enjoy this QRP issue. Let us hear from you!

. . . de KA1HY

GLOSSARY

DX Abbreviation for Long Distance. DX for the HF bands is typically anywhere out of North America.

Full-gallon Ham jargon for a kilowatt of output power.

HF High Frequency. Refers to the 160–10-meter (1.8 kHz–30 MHz) bands.

Isotropic Radiator A theoretical antenna that radiates equally in all directions.

Linear Amp Short for linear amplifier. This device takes an input signal and increases its power without (ideally) changing any other of its characteristics.

Linearity An expression of the resemblance between the input an output signals of a circuit. The better the linearity of a circuit, the less it distorts a signal.

Open up Ham jargon meaning "show good propagation." Refers to bands.

Propagation The transfer of energy (in this case, electro-magnetic energy) through medium or through space.

Purity Most often an expression relating the power of the fundamental frequency of a signal and the power of its non-fundamental frequencies, such as harmonics. The purer a signal, the more pronounced its fundamental relative to its non- fundamentals.

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It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 72. You'll notice a feedback card number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

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Cover photo by Karen Greene: Steven Roberts KA8OVA and Maggie Victor KA8ZYW (story on page 11) relax on Sullivan's Island off the coast of South Carolina.

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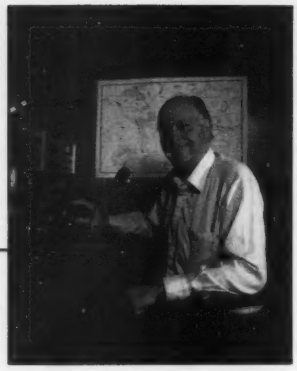

The Index

We've all been hearing and reading about the vaunted Information Age. Sadly, it hasn't had much effect on amateur radio so far. Indeed, other than for repeaters, incredibly little about amateur radio has changed for 99% of us in the last 30 years.

The biggest changes have been coming at us at work where most of us have to cope with telephone switching systems which are daunting. Many of us are doing well if we can remember 10% of the possible functions. Western Union and Postal Telegraph are now almost forgotten, as our businesses demand that we be comfortable with facsimile, telephone bulletin boards, Compuserve, The Source, MCI and local area computer networks.

At home we're either making do with 100-channel cable or a backyard satellite dish system—a couple of VCRs—projection TV. Meanwhile, at the ham rig we're still grumbling about AM being blown away and hunching down with our 1935 speed key while our grand-kids bewilder us with their Macintosh computers.

I got to thinking about the Information Age. I subscribe to about 250 magazines, so I have a fair idea of what is going on with magazine publishing...and I haven't seen diddly changing in magazines to help me cope with the information explosion. If you think about it, magazines are our main source of information, yet once a magazine is read and shelved, it's almost impossible to find that information again.

A Tiny Fraction

Yes, we can remember a tiny fraction of what we read—1% recall after six months is phenomenal. Yes, the yearly indexes help us to find particular articles we may want to check out again. But the sad fact is that even if we save our back issues, over 99% of the information we may want to find a few months or years later is a bitch to locate.

It's no news flash to you that I write editorials. You may not know that in addition to 73 I also write 'em for Digital Audio every month—bi-monthly for the Green CD Guide—bi-monthly for WHAT CD?—for Selling CDs—for Compact DJ—and the Green Congressional Technology Newsletter. So, in addition to trade, technical and consumer magazines, I also rely a good deal on technical and reference books...books which have darned good indexes. So why not, I said to myself, have an index for magazines just as we do in reference books?

An in-depth index to each issue of a magazine should greatly improve its value for reference. Suddenly 99% of the material would be easily found when wanted in the future. Each issue of 73 would then be similar to a volume of an ongoing encyclopedia of amateur radio.

The first step was to write a program that would automatically check through the text of each 73 issue and generate the index. David Torrey has done a fine job of this and the result is the index which started in the January issue. Check it out.

I'm hoping we'll be able to get our bulletin board up and running again so we'll be able to provide the monthly indexes for those wanting them. If there's enough of a demand we'll make it available on a floppy disk at the end of the year. At the least we'll be putting it out as a small reference booklet for each year.

Let me know what you think of the index. Please look it over and let me know how you think we can improve it. After all, it's there to make your issues of *73* more useful and valuable for you. Are we missing some subjects we should be cross-indexing?

Another Information Age Innovation

The second way I see for magazines to become more valu-

Continued on page 41

QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

QRM

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NEW!

Affordable DX-ing!

TS-140S

HF transceiver with general coverage receiver.

Compact, easy-to-use, full of operating enhancements, and feature packed. These words describe the new TS-140S HF transceiver. Setting the pace once again, Kenwood introduces new innovations in the world of "look-alike" transceivers!

- **Covers all HF Amateur bands with 100 W output.** General coverage receiver tunes from 50 kHz to 35 MHz. *(Receiver specifications guaranteed from 500 kHz to 30 MHz.)* Modifiable for HF MARS operation. *(Permit required).*
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- **New Feature! Programmable band marker.** Useful for staying within the limits of your ham license. For contesters, program in the suggested frequencies to prevent QRM to non-participants.
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- **RF power output control.**
- **AMTOR/PACKET compatible!**
- **Built-in VOX circuit.**
- **MC-43S UP/DOWN mic. included.**

Optional Accessories:

• **AT-130** compact antenna tuner • **AT-250** automatic antenna tuner • **HS-5/HS-6/HS-7** headphones • **IF-232C/IF-10C** computer interface • **MA-5/VP-1** HF mobile antenna (5 bands) • **MB-430** mobile bracket • **MC-43S** extra UP/DOWN hand mic. • **MC-55** (8-pin) goose neck mobile mic. • **MC-60A/MC-80/MC-85** desk mics. • **PG-2S** extra DC cable • **PS-430** power supply • **SP-40/SP-50B** mobile speakers • **SP-430** external speaker • **SW-100A/SW-200A/SW-2000** SWR/power meters • **TL-922A** 2 kW PEP linear amplifier (not for CW QSK) • **TU-8** CTCSS tone unit • **YG-455C-1** 500 Hz deluxe CW filter, **YK-455C-1** New 500 Hz CW filter.

TS-680S

All-mode multi-bander

- 6m (50-54 MHz) 10 W output plus all HF Amateur bands (100 W output).
- Extended 6m receiver frequency range 45 MHz to 60 MHz. Specs. guaranteed from 50 to 54 MHz.
- Same functions of the TS-140S except optional VOX (VOX-4 required for VOX operation).
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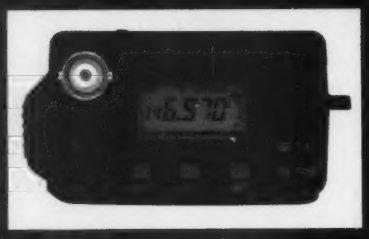
NEW!

Compact Breakthrough!



TH-25AT/45AT

New Pocket Portable Transceivers

The all-new TH-25 Series of pocket transceivers is here! Wide-band frequency coverage, LCD display, 5 watt option, plus...

- Frequency coverage: **TH-25AT:** 141-163 MHz (Rx); 144-148 MHz (Tx). (Modifiable for MARS/CAP. Permits required.)
  TH-45AT: 438-450 MHz.
- Automatic Power Control (APC) circuit for reliable RF output and final protection.
- 14 memories; two for **any** "odd split" (5 kHz steps).
- Automatic offset selection (TH-25AT).
- 5 Watts from 12 VDC or PB-8 battery pack.
- Large multi-function LCD display.
- Rotary dial selects memory, frequency, CTCSS and scan direction.
- T-ALERT for quiet monitoring. Tone Alert beeps when squelch is opened.
- Band scan and memory scan.
- Automatic "power off" circuit.
- Water resistant.
- CTCSS encoder/decoder optional (TSU-6).
- **Supplied accessories:** StubbyDuk, PB-6 battery pack for 2.5 watts output, wall charger, belt hook, wrist strap, water resistant dust caps.

Optional accessories:

• **PB-5** 7.2 V, 200 mAh NiCd pack for 2.5 W output • **PB-6** 7.2 V, 600 mAh NiCd pack • **PB-7** 7.2 V, 1100 mAh NiCd pack • **PB-8** 12 V, 600 mAh NiCd for 5 W output • **PB-9** 7.2 V, 600 mAh NiCd with built-in charger • **BC-10** Compact charger • **BC-11** Rapid charger • **BT-6** AAA battery case • **DC-1/PG-2V** DC adapter • **HMC-2** Headset with VOX and PTT • **SC-14, 15, 16** Soft cases • **SMC-30/31** Speaker mics. • **TSU-6** CTCSS decode unit • **WR-1** Water resistant bag

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QRX . . .

EDITED BY BRYAN HASTINGS KA1HY

Coordination Update

Another regional coordination body has been formed. In late October of last year, eight North Central repeater coordinators and councils met in Ohio to form the Great Lakes Coordination Conference. This action occurred in the wake of a regional coordination council formed among several northeastern area councils.

The creation of these two new regional entities means that most coordinators and councils east of the Mississippi River, and most of those in the Midwest, are now covered by umbrella coordination organizations. The western states lag in their efforts to coordinate coordination councils.

Up, Up and Away

The European Space Agency's satellite launches are so far on a smooth track. The Ariane V-20 Mission, the twentieth in the European Consortium's program, lifted off from its pad in Kourou in French Guiana without a hitch on November 21st, and deposited its payload into geosynchronous orbit 15 minutes later.

This success still leaves the launch date for V-22, with AMSAT Phase 3C satellite as part of its payload, set for early this year.

TVI Shoes

We may never stop marveling at the varied sources of RFI! The following appeared in Zimbabwe's Harare Herald.

Zimbabwe is a south central African nation, formerly called Rhodesia.

A strange source of TV and FM radio reception interference was discovered there. According to a spokesman for three leading footwear manufacturers, the TVI source was traced to the shoes worn by viewers and listeners!

The problem is confined to some shoes made during the last two years using hides from cattle and elephant that came from drought-stricken areas. Because of the lack of grass, the animals were forced to eat a certain type of weed that contained a large concentration of aluminum salts.

Acting as tiny transistors, the components of the contaminated hides interacted and set up static discharges on shoes that were worn in dry carpeted rooms. Viewers and listeners were forced to move their feet to stop the TVI.

The "radio shoes" came to light, the Harare Herald said, when a senior technical executive of one of the shoe companies was dancing to FM "Radio Three" in his living room. He was astounded when, as he moved back and forth, the FM radio interference level synchronized with his dancing. Discreet contact with other shoe companies confirmed his suspicions.

Cross-Satellite Contacts

G4COU recently made crosslink contacts with WA3ETD, according to G3IOR. On November 27th the pair hooked up via an AO-10-to-FO-12 link. The uplink to AO-10 was on 70cm, giving a downlink on 2m. That downlink was picked up by FO-12's Mode JA receiver and resulted in an FO-12 downlink at 70cm.

On the same day, Dave G4CUO heard Andy OK3AU through RS-11 and FO-12. The 2m downlink of RS-11 running Mode KT (15m up, 10m and 2m down) was picked up by FO-12's Mode JA receiver. Dave listened to Andy's on the FO-12's Mode JA 70cm downlink.

Satellite crosslinking has been done in 1975 between AO-6 and AO-7, and in 1986 Between AO-10 and FO-12.

SO1A

Naama SO1A has been on regularly from the Western Sahara. Listen for him on 28.315 MHz. He also holds skeds with EA2JG on 3.791 MHz.

The Eyes Have It

When 18-year-old Dennis Dugger emerged from a coma last January, he could neither walk nor talk. The only motion his paralyzed body permitted was eye-blinking.

Witnessing the helpless frustration that the motorcycle-accident victim felt in trying to communicate spurred an invention. The hospital administrator, Steve Shipley, and Dennis' ham father developed a circuit that fits in a small box about the size of a cigarette pack. This circuit is wired to a small infrared light sensor that transforms eye-blinks into audible tones. The wire and sensor mounts on Dugger's glasses to detect reflected light off his eyelids.

Shipley had hung a chart of the Morse code next to Dugger's bed, who surprised everyone by learning the code in two days. Dugger was so eager to communicate that hams had to be called in to decode his rapid eye blinking. Shipley avers that the increased communication sped Dugger's recovery, because he could relate how he was feeling and so be helped. Dugger has recovered to the point where he can speak in a whisper and walk with crutches.

Shipley patented his device, which he calls Opticom, and is working on another model to translate eyeblinks into printed and voice-synthesized words.

70cm Threat

Canadian hams and hamsat users are concerned about the proposed installation of a one megawatt, 433 MHz windshear detector at Toronto's Pearson International Airport. The air safety device could seriously disrupt both terrestrial and satellite communications on 70cm. There are several other frequencies suitable for the detector, but the Canadian military has precluded their use. The CRRL has filed comments opposing the detector's use in the 70cm band.

"10-Q"

To all who contributed news items this month. They are: Westlink, W5YI Report, CRRL Newsletter, CAREN's World, and the Daily Camera of Boulder, CO. Please send your news items, news photos, and other items of ham news interest to: 73 Magazine, 70 Rte. 202N, Peterborough NH 03458-1194; Attn: QRX.

The British Army's parachute team add a little excitement to GB4JUL operations last summer at a joint US-UK celebration of American Independence Day near Harrogate, North Yorkshire. Readers are reminded that the US does have a limited third party traffic agreement with British special event stations. The GB calls are issued without fee by the RSGB. Photo by G3DUW.

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New 220 MHz

220: FM for All!

Kenwood brings you a wide range of 220 MHz gear designed for every need. Choose from two types of mobile and two types of HT. The TH-315A is a full-featured HT covering 220 - 225 MHz. Ten memory channels and 2.5 watts of power. (5 W with PB-1 or 12 V DC.) Uses the same accessories as the TH-215A for 2 meters or TH-415A 440 MHz. For truly pocket portability, choose the TH-31BT, a thumb-wheel programmable, 1 watt unit. For mobile use, select the TM-321A or TM-3530A.

The TM-321A is the 25 W, 220 MHz, 14 channel version of the super popular, super compact TM-221A. The 25 watt TM-3530A has 23 channels, a 15 telephone number memory and auto dialer. Direct keyboard frequency entry and front panel DTMF pad enhances operating convenience. Novice to Amateur Extra, these transceivers will put everyone on the air "Kenwood Style"!

TH-315A
Full-featured HT

TM-321A
Compact mobile transceiver

TH-31BT/41A
Pocket-held HT

New

New

TM-3530A
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A complete line of accessories is available for all models.

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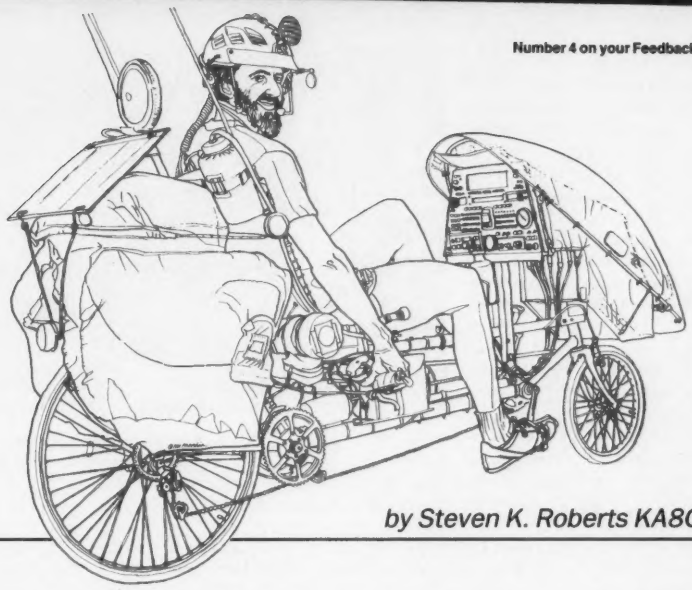
On the Road and On the Air

Tales of a High-Tech Nomad



by Steven K. Roberts KA8OVA

I think the dream started when I was a WN4 back in grade school: Someday I would wander the world on an electronic bicycle bedecked with radio gear and arcane instrumentation. It was a delightful fantasy, fueled by Carl & Jerry and the hobby rags of the day . . . but I'm sure I didn't really believe that as an adult I would live full-time on a pedal-powered solar ham shack with five computers and 1.7 megabytes of memory—or that I'd be able to digitally link cross-country via satellite while pedaling along a quiet country road. Like millions of other kids, I just had a passion for knobs, switches, and bikes.

But twenty years later in the spring of 1983, chained to a suburban desk in Genericsville, USA, it suddenly occurred to me that my old fantasy was ripening—that the tools becoming available could actually allow me to maintain a free-lance-writing and consulting business while traveling full time. My product, after all, is information—and information has no mass. So why attach it to things that do? All I needed was a laptop computer, a network for data communications, a few watts of solar power, and a comfortable bicycle, robust and efficient enough to carry it all.

Driven by obsession, I set to work compressing my lifestyle into a rolling system of waterproof packs. Six months later, I pedaled away from Columbus into a new life of daily change . . . with all I owned either bungeed onto my 8-foot-long recumbent or connected to it via modem.

For nearly two years I traveled America, covering ten thousand miles in a freewheeling adventure that ranged from blazing passion to aching loneliness, from bizarre encounters to private moments of life-changing insight. Through it all, I kept writing on my H-P portable computer—yielding dozens of magazine articles and my fourth book (*Computing Across America—The Bicycle Odyssey of a High-tech Nomad*). It was indeed the fulfillment of my fantasy, but there were three big problems:

I grew tired of traveling alone.
I couldn't use the computer while riding.
I had no ham radio.

The Winnebiko II

During a one-year layover, both supported and motivated to hit the road by a real *job*, I completely rebuilt the Winnebiko . . . added extensive ham radio and computer equipment . . . and found a new girlfriend (Maggie KA8ZYW) willing to trash her lifestyle, get a ham license, and move to a bicycle. Life hasn't been the same since.

The system shown in the photos has been called a rolling caricature of the information age—it's a self-contained machine that has been my home and office for over 15,000 miles. Using a binary handlebar keyboard I can edit text, manage files, update the bike software, or even run a packet QSO while pedaling down the road. Twenty watts of solar modules charge 17 amp-hours of batteries, with a box of high-efficiency switching power supplies generating 5 subsidiary voltages. A security system can respond to motion by uttering a warning message through the speech synthesizer, setting off a siren, or paging me up to 3 miles away—and I can control many of the bike's functions via touch-tone commands from a 2-meter HT. A network of five CMOS microcomputers reconfigures itself on the fly to support the activity in progress. And the ham gear has grown to

include a pair of 2-meter rigs, a 10-meter handheld, a full HF QRP system, and a packet station complete with mailbox software for unattended operation.

A serious trade-off in any pedal-powered contrivance involves gravity, however, and the Winnebiko is heavily affected. Total system weight without my body is 275 pounds (which is one of the reasons for the 54-speed gearing system and disc brakes). Overall length including the trailer is about 12 feet—matched by the De Felice recumbent piloted by Maggie. Pedaling side-by-side, holding hands with our antenna-flags waving in the breeze and solar panels sparkling blue, we look for all the world like a rolling showpiece of alien technology.

Photo A. Called a rolling caricature of the information age, Steve Roberts' bike is a self-contained machine that has been his home and office for over 15,000 miles. (Photo courtesy of GEnie, General Electric Informaiton Services.)

So how does this system work? Why am I doing this? What's next? This article kicks off an article series by introducing the Winnebiko II from seven perspectives . . .

The Computers

The most celebrated feature of the bike from the media standpoint has always been its information-processing capability. The original motivation behind all this was the need to make intelligent business use of my pedaling time—for every 20,000 miles translates into about 2,000 hours (a full business year).

I have always carried a laptop, of course, and still do. The Hewlett-Packard Portable Plus is a robust MS-DOS machine with 1.2 megabytes of RAMdisk and all major applications software baked into ROM . . . and I carry a battery-powered 3.5-inch disk drive for archives. A daily routine involves hooking the HP to the nearest telephone and logging onto the GEnie™ network for my mail, with everything from reader responses to manuscripts routinely passing through my modem.

But however wonderful the 9-pound machine is when I'm in camp, it becomes a piece of high-tech luggage when I'm rolling. Somewhere in West Texas with a deadline on my tail, it abruptly occurred to me that I could vastly improve my effectiveness if I could only write while riding.

Capturing ideas on-the-road now involves two other computers. A Radio Shack Model 100, heavily modified, has been built into the control console, with its screen located at top center to minimize eye movement. The tiny 32K memory that came with the machine is now only workspace, for with Traveling Software's "Booster Pak" I have upgraded the lowly Model 100 to a quarter-megabyte of RAMdisk—plus extensive ROM software including an on-line dictionary, tree-structured operating system, database manager, and even a brisk asteroids game for arcade-style entertainment on those long desert highways.

But where's the keyboard? In the handlebars, of course! Eight waterproof buttons nestled on the underside of the grips comprise an efficient binary input device, with the feeling of typing comparable to playing a flute. A Motorola 68HC11 microprocessor (the bicycle control processor, or BCP) spends much of its time decoding and debouncing the handlebar inputs, mapping them onto the virtual switch matrix that the Model 100 still believes is attached to its keyboard port. A few 74HC chips complete the interface, waiting for the appropriate column strobe for each character and delivering the corresponding row codes.

When I'm on a roll with all this, I can type comfortably at 30 words per minute—about half my normal QWERTY speed.

The BCP has a number of other jobs as well (see Figure 1). It manages the communications among the other processors (including the packet TNC) by issuing control bits to a crossbar network of analog switches. In "remote mode," it responds to touch-tone commands received by the Yaesu 290—speaking to passers-by or performing security functions. It monitors system variables ranging from battery health to error conditions, and it determines the overall "flavor" of my interaction with the bike.

All in all, the architecture of this Grand Turing (o-less) Machine gives me maximum flexibility: the software simplicity of a multi-processor environment, a flexible hierarchy that supports ongoing expansion, and a battery-powered system that can be phased down to minimize current drain.

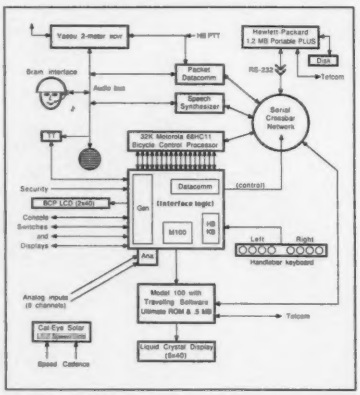


Fig. 1. The Winnebiko control system's internal architecture.

Bicycle-Mobile Packet

Perhaps the most entertaining confluence of digital reliability and radio black magic these days is packet, and it has become an essential component of my traveling circuits. There's something deliciously mad about playing NET/ROMulan while cranking hard through the hills of North Carolina, sending text through the satellite wormhole while causing miniature waves of future shock among passing locals.

On the practical side, my bicycle-mobile packet station has become an excellent door-opener in ham communities across the nation. I can sign onto a local PBBS from a hundred miles out of town or find myself in a live packet QSO while inbound. On many occasions, I have sent NTS traffic to new friends from the road, thanking them for their recent hospitality and letting them know we survived the City. And, of course, the growing packet mail network has become an important layer in the closest thing I have to a hometown: Dataspace.

The TNC on the bike is, of course, CMOS—the TNC-200 from Pac-Comm. With its LEDs remoted to the console and its on-board power supplies disabled, this product has been a trouble-free data communications link. And I have recently added custom Model 100 PBBS software with some unusual features. In addition to taking messages and paging me, this system offers short downloadable system descriptions, beacon management from the menu, and remote control or status-checking from a second TNC. Why a BBS on a bicycle? It's one of the best features of the system. I can now arrive in an unfamiliar town, initiate a beacon identfying the bicycle-mobile packet station, and stop for dinner—then emerge from the restaurant an hour later to find mail waiting on the bike from local packeteers! The welcome message explains enough about what we're doing to whet the appetite of *any* serious technoid.

But there's an interesting problem with all this mobile packet equipment. How can I have a stable network address while moving around the country? On-board PBBS or no, without constant juggling of everybody's forwarding tables and the White Pages, I'd have messages chasing me all over the US of A. Indeed, this is what was happening until recently—address management was getting to be such a nuisance that I was seriously considering limiting my packet activity to local contacts only.

But I now have a stable home BBS: the address is KA8OVA @ WA4ONG. Jim DeArras in Richmond is WA4ONG, and his

system is a very active 4-port BBS with Buckmaster's new online CD-ROM call directory. Any mail for KA8OVA or KA8ZYW gets forwarded into a local file, which is automatically transmitted to my mailbox (WORDY) on the GEnie™ network. While online, Jim's C program also forwards any mail from me into the packet gateway. The whole system is elegant and low-overhead—with packet messages simply showing up in my electronic IN-basket no matter where I happen to be. Ain't technology wonderful?

Incidentally, I don't need to sit on the bike and play the handlebar keyboard to run packet. A front-panel DB-9 accepts a cable to the HP, from which I can directly interact with any of the four console system processors. This is the mode I use when in the tent, beside the road, or parked in a host's garage.

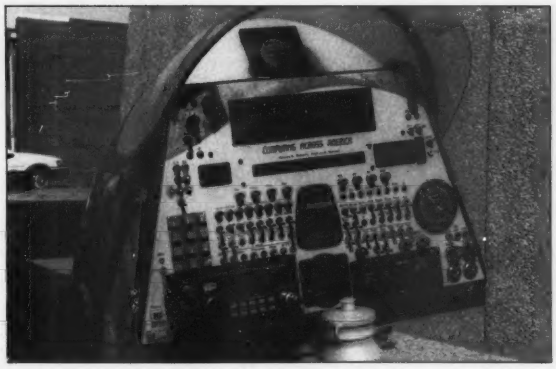


Photo B. A view of the Winnebiko's console. (Photo courtesy of GEnie, General Electric Information Services.)

2-Meter FM

It's very difficult to imagine how I ever traveled without 2-meter FM. Alone during that first 10,000 miles, I must have passed through the coverage areas of thousands of repeaters—vaguely sensing the electronic community swirling around me but never connecting. I seldom lacked company, of course, given the bizarre 2-wheeled door-opener sparkling beneath me, but those endless hours alone on the road...pedaling... pedaling.

A lot has changed. Built into the control console is Yaesu's new FT-290R multimode 2-meter rig—the ideal choice for this application. Every automotive transceiver I found was a power hog. Every handheld rig bristled with controls on all sides and was thus impossible to panel-mount. But the 290 is intended for portable operation (roughly 100 mA standby), it's smooth and easy to operate, and it lends itself well to console installation and interfacing.

Operation is easy. There is a Plantronics headset built into my bicycle helmet (the "brain interface unit"), and a push-to-talk switch in the left handlebar just under my thumb. For fixed operation, I simply plug in the standard Yaesu touch-tone mike.

Speaking of touch-tones, I have added an SSI-20C90 chip between the radio and the BCP. The telephone-grade pad shown in the console photo has always been a bit of a pain to use, so I have switched to software-controlled dialing. From the handlebar keys, a special command tells the processor to buffer a sequence, which is then transmitted to the radio upon receipt of termination code. Since repeaters differ widely in timing requirements, there is also a pass-through mode with an adjustable "software one-shot" on the PTT line.

The 20C90 chip receives touch-tones as well, and it is this feature that allows me to remote-control the bike through the Yaesu. From my HT, I transmit short command sequences which tell the BCP to do any of the following:

- Speak one of 32 pre-programmed utterances via the Votrax
- Sound the siren for N seconds
- Transmit local audio from the bike for N seconds
- Pipe received audio to the console speaker
- Turn yellow flasher on or off
- Enable/disable security system

The value of all this is most apparent in a "security" mode. When I'm away from the machine, I don't want to worry about what's going on around it. If my beeper sounds, I simply tell the bike to transmit 10 seconds of local audio, then select an appropriate speech string for it to say to the people standing around. "Do not touch, or you will be vaporized by a laser beam!" is a big favorite, as is: "Hi there, pretty girl. Would you like to ride on me?" If it becomes necessary to genuinely intimidate someone messing with the bike, I dispense with the cute stuff and instead trigger a 130-dB siren (which can also be set to happen automatically upon motion detection).

Maggie has a 2-meter rig on her machine as well—Yaesu's original 290, similarly installed on her front panel and powered by a solar-charged battery. We spend most of our on-the-road time on 145.52 simplex, and can honestly state that ham radio has saved our relationship: it's hard to imagine sharing a bicycle tour without some form of radio communications!

HF QRP

While 2-meter FM is a great tool for routine local conversation, it lacks the thrill and mystery of HF (Yes, you kilowatts out there, there really *is* mystery in the airwaves). I agonized over it for months and finally did it. My bike trailer now contains a Ten-Tec Argonaut 515 with all the attachments, a bag of dipoles and coax, a 4 amp-hour SAFT NiCd, and the new "DX Handy" 10-meter monobander from AEA.

Weight and power restrictions naturally constrain me to QRP operation, but it fits the whole spirit of a bicycle odyssey. In the first month of occasional use (which translates into getting on the air whenever I'm in one place long enough to finish urgent writing projects and throw a dipole in the trees), I worked Germany and 15 states—plus the Canary Islands on 10-meter sideband with the 2-watt AEA handheld. Have you ever really *thought* about this?

Well, think about it. You take some sliced rock, expose it to sunlight, store the resulting electrical current in a small box of chemicals—then shake it up to a few Megahertz, modulate it with your voice or wiggling fingers, and shove it out into a wire. Total power dissipated is about that of a penlight or small Christmas tree bulb.

Through a process that can best be described as magic (despite efforts to the contrary in textbooks), your signal disturbs a slice of the electromagnetic spectrum. Thousands of miles away, a stranger notices this and invokes a similar process to call you by name. Isn't this a bit wondrous? Somehow, doing it all with solar power and a bicycle-borne mini-station emphasizes the drama...for I've grown quite jaded with 99%-reliable network communications after 5 years of life in Dataspace. But chatting across the planet with a whisper of RF is an event worthy of celebration...and this highlights a major gap in the tools of our microculture:

How, exactly, do you express enthusiasm on CW? Working VE7BRR in 150 Mile House, British Columbia, on 2 watts from the East Coast one night, I was moved to exclaim my delight. *But there's no exclamation mark in the Morse code!* I propose that we fix that, at least informally, by adopting the new symbol WW (short for WOW), as the Morse exclamation point. Next time you find yourself about to default to the boring old "HI HI" when what you really mean is *hotdamn!* try didahdahdidahdah.

I suggest this as a reminder that underneath the technical gee-whiz and contact tallying there lies a human element—which translates into a major resource of friends and intelligent contacts around the world. Once we get past the Name, QTH, RST, RIG, ANT, and WX data, there's a lot to learn... unknown doors to open...and many new friends to be had.

But keeping track of all those people gets to be an interesting problem, especially when you live on a bicycle. One of the HP's jobs is to maintain my "hospitality database," a key resource for finding places to sleep. (The latest repeater directory helps, too, as do packet node lists.) But now I also carry a call directory of all US hams on microfiche, produced by Buckmaster Publishing. Three separate packs with a total of 27 4 x 6-inch fiches allow me to search by call, name, or city—a priceless resource in a venture such as this where the bottom line always seems to be measured in human terms.

So what's ahead for the bike's HF system? I'm about to have a go at mobile 10-meter CW operation—using the handlebar key-

board and the Model 100 to generate code and the console LCD to display incoming and outgoing text. With the sunspots coming around, things are going to get mighty strange in that band...

Solar Power System

"So how do you power that radio?" It's a common question on the local repeaters, but the answer goes far beyond the basic triad of photovoltaic modules, charge controllers, and batteries. My entire existence—entertainment, business, and road survival—depends upon a stable electrical power system.

A key word here is redundancy. There are two Solarex 10-watt photovoltaic modules charging a pair of 5-amp-hour lead-acid batteries (no NiCds here—the duty cycles are too random). One battery is dedicated to computers, and the other runs lights and the Yaesu 290. Console switches allow the panels to be swapped relative to the batteries—or the batteries to be swapped relative to the loads. This arrangement allows the computer battery to become a backup for the lights during long night rides...and it also lets me compensate for uneven illumination on the two panels since the rear PV module is almost fully shaded when I'm southbound this time of year. Charge management is handled by a trivial zener/check diode circuit.

Sometimes it's necessary to charge from the AC line, especially after extended rainy periods or marathon night rides. A dedicated LH Research switching power supply is built in, with console switches determining which battery gets to benefit from the power line. To eliminate a heavy current-limiter, I simply switch the mode of the headlight when charging the batteries from AC—putting it in series with the switcher. A soft glow tells me I'm getting about 400 mA.

The system described so far yields a pair of self-maintaining 12-volt bike system power buses, but there are a few other requirements. The HF rig, as mentioned, has its own NiCd (deep-cycling is appropriate here, unlike in the console). And the H P computer has about 2.5 amp-hours of lead-acid battery (25 hours worth), which can be fed solar current by a cable to the trailer or AC by a plug-in charger.

Subsidiary voltages—five of them—are produced by a small aluminum box of switching supplies, all running from 12 volts and switched in and out of micropower standby mode as needed. These are based on Linear Technologies LT-1070 chips running at about 50 kHz, and were created by Glenn Glassner of Columbus, Ohio. Producing up to 3 amps of 5 volts and 1 amp each of 3, 6, 9, and -12, this efficient unit takes care of all loads in the Winnebiko system.

I can monitor all this with an Acculex digital panel meter, a delightful little unit that requires absolutely no overhead and no noticeable supply current. You can see it in the control panel photo, displaying .28 amps of net charge current—along with a neighboring thumbwheel switch that feeds it any of the system power buses, the output of either LM10 charge current monitor, or the input from a front-panel test jack.

The bike's electrical loads are diverse. All voltages appear on front-panel jacks for accessories like the micro-TV or tent light—and various forms of charge current are likewise available to handle external batteries. The 5-volt supply is heavily filtered for the logic boards, the 6-volt supply runs the Model 100, and the 3-volt supply takes care of entertainment electronics. And the 12, well: it runs headlight, dimmable helmet/console light, tail light, red trailer flashers, yellow barricade flasher, siren, security system, 2-meter rig, an occasionally handy CB, and even a cooling fan for the greenhouse that exists between the dark blue forward solar panel and the clear Lexan™ fairing. Naturally, with all the potential for problems in this difficult mobile environment, all supplies are fused, switched, current-limited, and filtered.

Packaging and Maintenance

This is one of those issues that can take an otherwise solid design and quickly turn it into scrap. The Winnebiko II control system has withstood thousands of miles of heat, cold, vibration, potholes, crashes, condensation, lightning, static, human abuse, and most recently, a pickup-truck door in Whiteville, NC. Even when ragged Washington, DC, roads rattled my fillings and bent the unbendable 48-spoke undished wheel, the BCP kept on ticking, flashing its little green "OK" LED in blissful ignorance of the brutal pounding going on around it.

The entire console system unfolds for service, and can be removed from the bike by popping three toggle clamps, unplugging six waterproof Lemo connectors, and lifting straight up from the padded 70-75 aluminum support platforms. Years of industrial control system design taught me the value of equipment serviceability, for no matter how perfect a prototype may seem it is but a rough approximation of what it will someday become. That has certainly been the case here—bike control software is now at revision level 15.2, and my once-pristine documentation binder has been scarred by countless erasures, patches, afterthoughts, and TO-DO lists. No complex system is ever 100% complete...or correct.

With all this in mind, I built the system to support extensive diagnostics and development. Only rarely have actual repairs been necessary, but more times than I care to remember I have hunkered over the system in a campground with logic probe in hand, obsessed with getting the latest enhancement to work. Documentation is always a major issue, of course, so in addition to the paper binder of schematics I carry a miniature Keyan microfiche viewer with a large collection of IC databooks and system manuals on film. (And what high-tech bicycle would be complete without a robust "junkbag" of 74HC chips and tinkering stock?)

The control panel itself began life as a sheet of .090 aluminum, with the sides folded back and the corners TIG welded. I used a Bridgeport milling machine to cut the holes, and made press-fit abrasion-resistant Lexan™ windows to cover the LCDs. The unit was then bead-blasted and anodized, lettered with dry transfers through a two-step centering process and protected with 35 coats of Krylon, interspersed with five baking cycles.

So how does it stand the weather? On the road, a major issue is rain—which occurs very reliably whenever we camp or hit the road after a sunny indoor layover. The front panel can be protected with a clear Velcro-on cover that forms an effective seal with both fabric side curtains and the console aluminum itself. All this is under the fairing, and further steps have been taken to insure that no splashed or wheel-flung water can work its way up into the electronics. So far, the arrangement has kept the elements out of the system...and I often wish that my body could receive the same level of protection.

Fortunately, skin is highly water-resistant.

Life on the Road

Finally, let's take a quick look at the lifestyle that results from all this.

Thanks to communications systems ranging from computer networking to ham radio, it no longer matters where in the country we are. Business goes on. The term "wheeling and dealing" has taken on new meaning... and freelance writing no longer keeps me off the streets. As long as there's a little sunshine to charge my batteries, I have reliable human contact and computing power. As long as there's a phone line for the modem, I can run the company.

The net effect of all this is that "home" has become a three-part affair, a surprisingly tangible substrate for my nomadic existence. The most obvious component is our whole electronic cottage on wheels, of course—the 500-pound assemblage of tools, toys, and bicycles that keeps us going. Then there's America itself, a 3.5-million square mile neighborhood that we prowl slowly from season to season. And then, profoundly important but very hard to explain to the media, there is the multilayered network of human contacts—part Dataspace, part ham radio—that keeps the loneliness at bay.

You see, we never really leave home at all. It's inside us, around us, permeating our daily existence like water and sweat, fresh air and exhaust. The road has come to represent stability: a strange but deeply familiar blend of freedom and security. This is perhaps the greatest surprise of the journey—the discovery that change is an addiction and that the pleasure in new friendship never ends. With a bikeload of networking and ham radio gear, there will never be a shortage of either.

So I'll see you online...on the road...or on the air—and 73s from somewhere out there! 73

Steve Roberts can be reached at Computing Across America, 1013 Warren Ave., Cary NC 27511 (919/467-4806).

73 Review *by Mike Bryce WB8VGE*

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AEA DX 10m Handy Review

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Over the years our handhelds have changed. They have gotten smaller and smaller with more bells and whistles than many larger HF rigs! I can even remember the Drake 22. Well, the DX Handy is a back-to-basics rig, using standard yet well thought-out circuits.

The DX Handy is a hand-held 28 MHz SSB transceiver with a QRP output of 2 watts. For those up to it, CW operation is possible with the built-in key. Operation frequency is crystal-controlled, with a VXO giving each crystal about 50 kHz range. With ten meters coming back strong, and with the new Novice enhancements, the DX Handy is something else. Hand-held DX may seem far-fetched, but not with the DX Handy.

The rig does not have a PLL, hence no PLL noise or birdies in the receiver. In most PLL-controlled handhelds, the speaker will cause the PLL to modulate at an audio rate, causing a nasty howl. The handy obviously does not suffer from this problem.

Solid Quality

An attractive, light gray metal case houses the DX handy. There is a good, solid feel of quality in the radio. Unlike most handhelds, it has no belt clip. Even with the whip antenna fully collapsed, the antenna sticks up about a foot. It would be a real kidney-killer if worn on the belt.

Four screws retain the front case, which should make crystal changes easy. Nylon washers under each screw protect the case.

Even the new operator will find operation a snap. The radiohas basic features and nothing more: off, on, volume and station selector—that's about it! There's not even a squelch control.

The DX Handy uses a variable crystal oscillator, or VXO.

The VXO warps the crystal's frequency by 50 kHz. The DX Handy has a two-position switch for any two 50 kHz segments in the 28 to 29 MHz amateur band. Either of two crystals can switch in from the front panel selector.

Crystals supplied with the DX Handy will cover 28.250–28.300 and 28.300–28.350—the middle of the new Novice phone bands on ten meters! You can place the DX Handy anywhere in the ten-meter band with optional crystals. Since most of the activity will be in the Novice subbands, the DX Handy will appeal to the new Novice market.

This is a lot of radio for its size. Top controls include the main VXO and receiver incremental tuning (RIT) knobs, the band segment (crystal) select switch and volume control. The top panel also provides a dual purpose S- and RF output meter and jacks for an external speaker and microphone.

The spacing between the speaker and the mike jack looks very close to that which ICOM uses in their line of handhelds. The ICOM speaker/mike does plug right into the DX Handy, but it doesn't work. The DX Handy requires a three-circuit plug for the microphone connection.

The antenna connector is a standard BNC. AEA supplies a base-loaded whip and a 8' 3" counterpoise wire in the package.

Other less-used controls are located on the bottom of the unit. These include the battery test and mode switches, and charging jack. CW operators can use either the external key jack at the bottom or use the CW key built into the top of the radio.

The DX Handy comes with six standard AA carbon-zinc batteries. While it is a nice gesture from AEA, give the batteries to the kids and go purchase a good set of alkaline batteries.

On the Air

The receiver pops alive when installing the whip antenna with the radio turned on. With a 10m band opening a quick tune of the VXO will turn up stations from all over the country. The very stable VXO exhibits good linearity. Also, the smooth, detent-centered RIT control has a tuning range of ±2.5 kHz.

Operation couldn't be simpler. Just extend the whip completely, tune in a station, push the side-mounted PTT button and talk. There is no microphone gain control to adjust. The red LED SEND indicator will light, and the RF output meter will deflect with the audio.

CW operation is a bit different. After proper band segment and mode selection, the operator must push the PTT button and key the radio, either by using the small push-button on the top, or an external keyer. In either case, the operator must keep the PTT button depressed. Also, AEA apparently overlooked the need to produce a CW sidetone.

At first I could not believe a handheld could produce such excellent receive audio. Several reports proved the excellence of the transmit audio, too. Most contacts did not believe I was using a hand-held radio.

Notice in Figure 1, the noise blanker is much more than two diodes back to back. The noise blanker works quite well on impulse noise like that produced by automobiles.

There is nothing like working someone with a watt or two. The DX Handy is no pileup cracker, and QRP operation is not push-button communications. The uniqueness of ten meter often produces surprising results. After weeks of quiet on the band, a good opening will prove the handy's two watts more than adequate to make most contacts.

A counterpoise wire greatly improves the performance of the whip antenna. The supplied wire attaches to a screw on the radio. A dipole, a quarter-wave vertical, or a small beam may help immensely, too.

The manual that comes with the DX Handy explains other operating hints as well as different antennas to use. The booklet contains much information about working and calling stations in the phone bands. This is aimed at the Novice user. The schematic of the DX Handy, however, is very hard on the eyes. Also, there were no troubleshooting guides, or any text on how the radio works.

Operators using NiCds in the DX Handy will use the charger plug on the bottom. Failure to turn the radio off and switch over to operate without unplugging the 12 volts will cook the radio. The dummy battery is a must when using alkaline batteries. AEA does effusively warn about this, and even includes two schematics of preregulators to build to prevent this from happening. To ease a lot of burden from both the end-user and the AEA service techs, AEA should have allowed for a built-in regulator to run the unit directly from a 12-volt source. Apparently, anything over 12 volts input will damage the unit and void the warranty. That's my one big complaint—the only other down points were no sidetone and an easier-on-the fingers PTT.

The proof of the pudding is that it works. My first QSO may not set records, but it sure was fun. I was standing in my backyard talking to N6AKO in California: Coast-to-coast S-9 communication with only two watts of RF, the whip antenna and the counterpoise wire! That, my friends, is a lot of fun; and that is what you can have with the DX Handy. 73

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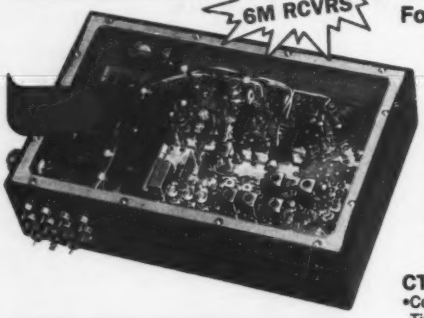

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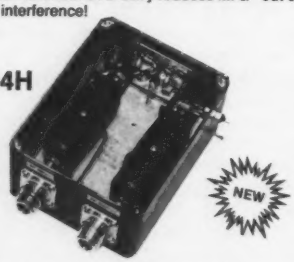

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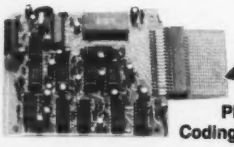

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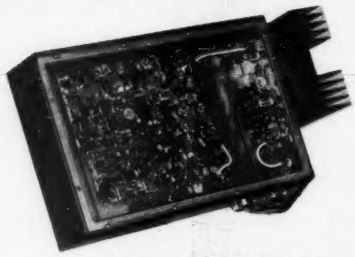

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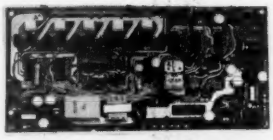

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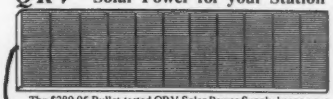

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73 Review *by Marc Stern, N1BLH*

Kenwood TR-751A Multi-mode VHF Transceiver

A standard for years to come.

Kenwood USA Corporation
2201 E. Dominguez St.
Long Beach CA 90810
Price Class: $630

An old saw claims that the more things change, the more they stay the same. It's only partly true for amateur radio. Radios still transmit and receive, and still use RF, but features of our radios have changed radically over the years.

Hams in the hobby more than five years will have seen HF rigs become synthesized, miniaturized, and microcomputer-controlled. HF rigs now have dual VFOs, built-in general coverage receivers, built-in narrow CW and SSB filtering, up to 100 memories, and the ability to be controlled by an external personal computer. There's even a rig—the Yaesu 767—that serves as the platform for not only a complete HF station, but also a fairly complete VHF/UHF station. An operator can add modules on it for 6 meters, 2 meters and 70 cm.

If this is the case for HF, imagine what's been happening at VHF and UHF.

Rigs have become incredibly compact and are still capable of 25 to 50 watts of output. VHF rigs have 10 to 20 memories and can have such items as built-in CTCSS tones for tone access, digitized voice, limited access, and liquid crystal displays.

Contrast this with one of the standards of a few years ago, the ICOM IC-255A. It was state of the art for 1980 and sported a microprocessor, light emitting diode display, dual VFOs, RIT, five memories, and high or low power. (All this is standard now.) It also had more than enough audio and was about as rugged a transceiver as we've run across in a long while.

However, the radio was big, on the order of about five pounds and measured in at about 6" x 8" x 2". Also, it didn't sport many of the features we take for granted today, such as repeater reverse, repeater offsets stored with frequency, priority channel, built-in CTCSS tones, and the ability to resume scanning after it had found a busy frequency.

The state of the art only seven years ago was far different than it is now.

Today's Technology

Let's return to today's state-of-the-art and look at one of the more capable multimode VHF rigs on the market, the Kenwood TR-751A. It is an example of just how far the radio art has come in less than a decade.

For starters, the TR-751A has a GaAsFET front end, something that was only dreamed about a few years ago. This development radically increases the sensitivity and dynamic range of the TR-751A. In fact, when I checked my TR-751A against one of the standbys of the 2-meter multimode world, the ICOM IC-251, we found that the 251 needed a preamp to match the performance of the TR-751A right out of the box.

Further, the TR-751A is far more linear in its operation. While tuning through a signal with the IC-251, the operator can hear the distinct frequency changes in the signal's beat note. It sounds not unlike a multi-tone commercial paging device. In contrast, the TR-751A tunes smoothly through the signal with no trace of a changing beat note.

Automatic QSY

Introduced last year, the TR-751A's built-in microcomputer programming has an interesting feature. When in the Channel Search (CS) mode, the TR-751A waits for a similarly equipped Kenwood with the same feature activated. Once it senses that it has connected with another Channel Search-equipped transceiver, the TR-751A synchronizes with the other unit and they both hunt for an open simplex frequency—presuming they are in simplex range, of course—and both rigs automatically QSY.

It's a great way to keep repeater use to a minimum, especially when the operators are capable of simplex operation. How many times have high-power VHF transceivers been used for repeater operation from fixed stations? It seems that more and more, repeaters are replacing simplex or 75 meters for local ragchewing, which isn't the purpose of repeaters in the first place. Repeaters are meant to allow reliable mobile communication when two mobile stations are out of sight of one another or for low-power station-to-station work when the radio's output can't be used for simplex work. Hams outside North America tend to appreciate this point much more.

Front Panel

The TR-751A uses a liquid crystal display (LCD). Much like a personal computer's CRT, the backlighted, green LCD displays frequency down to the nearest 50 Hz. It also indicates whether the operator has the alert feature activated; the frequency increments (50 Hz, 5 kHz, etc.); memory recall mode; the shift (plus, minus or simplex) for FM and repeater work; optionalsubaudible tone selection; and the frequency lockout. Further, the LCD indicates when it is in "open channel" search mode, and when the coded squelch option has been activated. The "open channel" search is one of the newest features of the Kenwood VHF lineup.

The LCD also has a standby mode indicator, which shows the features in that mode, an indication the TR-751A is in memory mode, where the memory number is indicated, and whether the RIT is activated.

The TR-751A's front panel is clean, easy to use and, sensibly arranged. All of the functions dealing with frequency are grouped in the upper left, while functions applying solely to radio operation are grouped below. In the center is a large frequency selection dial, while mode and memory buttons are grouped to the right.

The rig features a genuine analog S/RF meter that doubles as a relative power output meter. It's a refreshing change in these days of LED metering. Just above and below the S/RF meter are the status indicators, and pushbuttons dealing with coded squelch (Digital Code Squelch) and Digital Channel Link (DCL) are in the upper right. Altogether, it's a well done and well thought out front panel.

Automatic Mode Selection

This unique feature is one of the nicest on the TR-751A. Kenwood took the ARRL bandplan and put it into silicon memory. The result is that the rig does some thinking for the operator. The allotted mode is called up automatically at a spin of the dial. For example, in the automatic mode when tuned below 144.100, the CW indicator lights up; above 144.100, the USB indicator is lighted. In the repeater segment of the band, the FM indicator automatically lights. It makes this multi-mode rig a pleasure to use not only in contests (mine has seen more than one) as well as mobile. Let the radio worry about which mode and concentrate on logging or driving.

Other Bennies

The TR-751A also has more than enough punch for most situations. With a high-power setting of about 25 watts (it measured about 28 on my wattmeter) and a low-power setting of 5 watts, I found that it had more than enough power for mobile and contest work. I used a four-element beam and a short length of feedline so the effected radiated power of the lash-up was more than competitive with other stations. The high power setting will also drive most makes of high-power amps to 200 watts.

Another nice feature is the large, finned heatsink. The TR-751A provides more than enough heatsinking to operate at high power for hours with no problems.

The Receiver Incremental Tuning is also a very nice feature. It only works on receive, but when used in conjunction with 50 Hz resolution of the LCD, the operator can zero easily in on any station. On the down side, only a small indicator in the display indicates the RIT is activated. The receiver frequency remains the same and the transmit/receive frequency offset is not obvious.

On the air, the GaAsFET front end easily picks up weak stations and, even though the rig is very sensitive, it didn't complain in the presence of other RF signals. There was some increase in received noise, but it wasn't bothersome. A small adjustment of the RF gain control took care of overly-loud stations.

The noise blanker is also effective against most kinds of pulse-induced noise, such as ignition noise. It managed to quiet more than one noisy ignition when I was using it mobile. The transmit and receive audio are superb in both FM and SSB modes.

The only things I fault are the documentation and the price. At over $600 for the basic rig without the Tone Encoder or Voice options, it is quite expensive, especially for a single band multimode rig. The rig offers FM, sideband and CW, as well as DCL and a GaAsFET front end, but it's just as true that it's only for one band, rather than two. I suppose it's as much a result of the yen-dollar readjustment, which has made just about every imported item expensive.

Documentation

The documentation seems as if it were written by a person with little knowledge of the American idiom. It's rough and makes little sense in places. However, it does come through in the areas where it has to: programming and using the rig. The graphics are first quality and carry the user guide where the language falls down.

Overall, I enjoy using my TR-751A. It has some great specifications and quality features. And, like its predecessor, the TR-9130, the TR-751A should be a standard for many years to come. 73

Marc N1BLH is an engineer at Digital Electronics in Boston. He reviews regularly for 73 and may be reached at 555 Worcester Rd. Framingham MA 01701.

Number 7 on your Feedback card

73 Review *by Larry Ledlow, Jr. NA5E*

Mobile Commodore 64 Porta-Pow'r-Pak

Who says the C-64 isn't portable?

Ludvigson Electronics
415 N. Duluth
Sioux Falls, SD 57104
Price Class: $80

Dave Ludvigson is a pretty clever guy. Commodore 64 users who could find uses for their computers in the field and on the road should love his latest offering. The Porta-Pow'r-Pak cuts those ties with the world of alternating current and allows the computer to go where the action is. Headed for foreign lands? The Porta-Pow'r-Pak is available for both American and European versions of the computer.

Porta-Pow'r-Pak provides the C-64 or C-64C with all the voltages necessary for proper operation from any 13.8 VDC source. It will support datasette, user port, and game cartridge attachments. Users are reminded that C-64 memory expansion modules require more current than the supply can provide, though. Normal C-64 current requirements are under 1.8 amperes.

The unit measures 6" x 3" x 1.5" and weighs less than 12 ounces. Three cooling fins atop the flat black case provide heat sinking. A fused cigarette lighter plug provides DC power to the unit, while a 7-pin DIN connector attaches to the computer.

The device is user-serviceable, and those who like to dig into products will find the glass epoxy circuit board and component placement very professional. This is a quality product.

During extended operation the Porta-Pow'r-Pak gets noticeably warm, and the documentation warns of keeping the unit away from heat sensitive materials like plastic. The supply's wiring should also be kept away from the cooling fins to prevent possible damage.

The instructions inluded with the prototype show how to modify a Commodore 1541 disk drive for 12 VDC and 110 VAC operation. These instructions could be somewhat more explicit and should include better artwork for the modification. A successful conversion will allow truly portable Commodore computing. The Porta-Pow'r-Pak manual also refers to a 1581 power supply, not yet available, which will allow portable disk operations, also.

Portable packeteers, emergency volunteers, and mobilers should find the Porta-Pow'r-Pak pretty darned handy. The C-64 is a proven workhorse in thousands of ham shacks, and now there's nothing keeping those computers from field or mobile use. Like I said, Dave is a clever guy, and this product is a fine example of his handiwork. 73

Deluxe Transverter for 1750 Meters

Your Ticket to the VLF Experimenter's Band

by David Curry WD4PLI

What could possibly be interesting about a group of frequencies that are so low, most people mistake them for bandwidth? Or how about an antenna that for all practical purposes could be long enough to be used as a telegraph line between two midwestern towns? These large dimensions, and the mystery that follows the 1750 meter band, are just a part of the fascination that a few people, often referred to as "Lowfers," share in experimenting and communicating on this otherwise neglected band.

Unknown to many amateur radio enthusiasts, the FCC has allowed license-free use of frequencies from 160 to 190 kHz, with a power restriction of up to 1 watt input to the final, and a maximum antenna length (including feedline) of 50 feet. There are no restrictions placed on the receiving equipment used or the type of receiving antenna.

Surprisingly, one watt often offers powerful flexibility. My CW beacon "PLI" transmitting on 183.63 kHz is regularly heard several hundred miles away. Another station, Z2 transmitting from San Simeon, CA, has received reception reports from even greater distances: over 2000 miles away in Hawaii! The FCC does not restrict the mode of transmission, and everything from AM and SSB to CW and RTTY have been used succesfully.

Few people have mastered the 1750-meter band because of the lack of readily-available commercial equipment. You simply don't go out and choose the transmitter, receiver, and antenna you want. In most cases, you have to build your own gear, and with the right equipment and the right choice of antenna, the 1750 meter band becomes truly addicting.

Easy to Build Transverter

Transverting from 80 meters provides a simple way to get onto the Experimenter's Band. Home-brew transceivers often present complications, but transverting from most commercial equipment eliminates most problems. When the transverter is in the receive mode, the 80-meter band of your transceiver is converted into a longwave receiver capable of receiving any signal from 5 to 450 kHz. Any type of signal from AM to FSK can be received, only limited by the mode capabilities of your ham transceiver. The transverter is broadband, and does not require tweaking nor tuning either for receive or transmit operations.

During transmit operation, you simply transmit normally on 80 meters between the legal band limits from 3.66 to 3.69 MHz. The signal is converted down converted from 160 to 190 kHz, which are the lower and upper frequency limits of the 1750-meter band.

Remember not to transmit outside the band limits, either below 160 kHz or above 190 kHz, because these frequencies are used heavily by government, aircraft, and many other services. The transverter features a bandpass filter to eliminate transmission outside the 1750 meter band, as well as harmonic energy above 200 kHz.

Much of the guesswork and trouble that often leads to disappointment is eliminated with this proven circuit, leaving more time to explore and enjoy this truly amateur band.

Transverter Mixer

The heart of transverter is, of course, the mixer MX1. It upconverts receive signals on the longwave band to 80 meters, and downconverts transmit signals from 80 meters to the 1750-meter band. Remember that 1750 meters (160–190 kHz) is just a small portion of total longwave spectrum and the only area where you are allowed to transmit. The circuit uses a doubly-balanced diode ring, which provides an excellent dynamic range, low noise, and local oscillator rejection. You might think it would be necessary to use two mixers, one for receiving and the other for transmitting, but the diode ring mixer is changed to either receive or transmit by the relays K1 and K2. This eliminates the need or cost of using two. Let's imagine the transverter in the receive mode and start at the beginning of the circuit with the input port J1.

Receive Conversion

As you can see in the schematic (Figure 1), the input signal flows from J1 through relay K1A to S1 which is the "receive select" switch. This switch is useful if a different antenna for receive is required for improved reception such as a loop or active whip. In the normal position, it's connected to the 1750-meter port, J1, or switched to the auxiliary input. The received signal is sent through switch S1 to the input of the low-pass Chebyshev filter, comprised of C1–C4 and L1, L2. This filter has a very sharp roll-off starting at 450 kHz, which eliminates overload or IMD from strong AM broadcast stations and other out-of-band signals. Signals below 450 kHz pass with minimum attenuation.

Filter output is matched into the input port of Q1, a low noise, high gain J-FET operating in a grounded-gate, broadband configuration. The grounded-gate type of operation is known for good stability and low signal distortion. The gain of the amplifier is approximately 10 dB and compensates for the 6 dB loss in the mixer and the 4 dB lost in Q4 and the low-pass filter. The transverter is set as close as possible to unity gain. Output of this stage is transformed to 50Ω via T1 and routed through K1B to the input of mixer MX-1.

Unique LO Design

The local oscillator used here is an unusual design, first brought to my attention from an article about crystal oscillators by Ulrich Rohde. What makes this circuit so worthwhile is the way the crystal, Y1, is configured between the oscillator transistor Q2, and the Class A amplifier, Q3. Y1 placed in this fashion acts as a high-Q filter, which greatly attenuates harmonics and local oscillator noise. Capacitor C9 is used to adjust the crystal frequency to 3.5 MHz. Q3 operates in the common base configuration and amplifies the LO to approximately +7 dBm. At this point, the Pi-matching circuit, consisting of C15, L5, and C16, match the output of Q3 to the 50Ω input impedance of mixer MX-1.

The sum and difference frequencies from the output of the mixer go directly to load resistor R9 and the input gate of Q4, which is

used as a source follower. This gives optimum isolation between the mixer output and the next stage. There is a loss in using this type of circuit—the source of Q4 and the next stage acts as a voltage divider—but the advantages outweigh this disadvantage.

By using R9 as a load resistor for the output of mixer MX-1, all the sum and difference frequencies including their harmonics will see a true 50Ω load, which optimizes the 3rd order intercept point. Gate capacitance of Q4 is minimal and ignorable at these frequencies. This approach obviates the need for triplexers in the receive and transmit path. The source of Q4 is coupled to the receive port of the 80-meter transceiver through relay K2A and K2B, and the DC blocking capacitor C17.

J4 provides +12 Volts DC for operating any accessories or preamplifiers during receive mode, and goes low during transmission.

Transmit Downconversion

This next situation is the transverter in the transmit state, taking an 80 meter transmit signal from the amateur transceiver and downconverting it to 1750 meters. Point J1 is used as the control point to turn the Transverter from transmit to receive, or visa versa, and is connected to the terminal on the back of the transceiver that has a NORMALLY-OPEN and COMMON relay points.

Almost all transceivers have auxiliary or accessory terminals for controlling outboard equipment like this. A careful look in the manual or even a check (with the help of a VOM) of each point on the terminal, will reveal the points corresponding to the normally-open, common, and normally-closed relay positions.

Usually, the accessory jack is female with eight or nine pins, and includes a normally-open, common or ground, and a normally-closed pin. The normally-closed pin is not used while the common is connected to ground, and the normally-open pin connected to J3 on the transverter. This will synchronize the transverter to the transceiver by energizing K1 and K2, when going from receive to transmit and vice versa. If no connection to the transceiver is possible, a manual switch can change the transverter mode. One part of the switch is connected to J3, and the other part of the switch goes to ground.

During transmit K1 and K2 are energized. The RF power from the transceiver goes into the 80-meter port J2, through K2B and into the 30 dB attenuator pad which consists of R13–R18, R19, and R20. This pad lowers the signal to an acceptable level for the mixer MX-1. The signal goes through relay K1B, and into the mixer where it is mixed with the local oscillator. The output sum and difference frequencies from the mixer are sent to the source-follower transistor Q4, then through K2A to the low pass filter comprised of C19, L6, and C20. The filter eliminates the sum frequencies around 3.68 MHz, but allows the difference frequencies from 160 to 190 kHz to pass.

With the signal already filtered, it is ready to be amplified to a usable output for transmission. Transistors Q5 and Q6 operating in Class-A mode amplify the low-level signal from the output of the filter to drive output transistor Q7. Q7 is an inexpensive, durable audio transistor that has ample gain at these frequencies for maximum performance. The bias that sets Q7 in class AB operation is controlled by regulating transistor Q10. R32 adjusts the current through Q10, which in turn controls the quiescent current of Q7.

The collector of the PA transistor Q7 is coupled to the 50 Ω output impedance by transformer T3. T3 and C30, C31 form a tank circuit with a loaded Q that is low enough to cover the entire 1750-meter band. The output power from T3 is passed through relay K1A to J1, which is the 1750-meter antenna port.

For best results, it is very important that the transmitting antenna resonate at the desired frequency, and coupled to the transmitter efficiently. The transmitter PA is flexible to various forms of matching circuits, and a proven method follows later.

The transverter operates from a 24 VDC regulated supply, or any well-filtered and regulated supply capable of delivering at least 1 amp from 18 to 26 VDC. Q12 supplies a regulated 12 volts to all active components except the PA transistor Q7, which uses the power directly from the 18 to 24 VDC power input.

Construction

Figure 2 shows the circuit board positive to aid construction. A ground plane on the component side of the circuit board adds stability. An easy way to make the ground plane is to cover the ground plane side of the circuit board with masking tape before etching the board. Make sure the corners are especially well-covered. Only the foil side is etched; the ground plane side is left untouched. Remove the tape after etching and drill the holes from the foil side. Finally, use a larger drill bit to countersink the holes from the ground plane side enough to adequately clear all part leads through the board. The ground holes do not need to be countersunk.

The parts are inserted into the board using the component layout (Figure 3), viewed from the foil side through the board to the actual component. Each type of component has its own symbol, as shown in the illustration, to help visualize the type of part and its value. All components, except for three resistors R16–R18 (which mount against the foil side), are mounted on top of the ground plane side and part leads soldered on the foil side. Some grounded leads are soldered on both sides to improve the ground on the foil side, and are marked in Fig. 4 by the symbol, "/". Install resistors and capacitors first.

Q7 also uses the ground plane of the circuit board as a heat sink. Use a mica insulator between it and the board, and cover both sides of the insulator with heat sink compound.

Wind all toroid inductors evenly and tightly, winding the side that has the most turns first. After a toroid has been wound, strip the enamel from the wire almost to the body of the toroid, and insert the leads carefully into the circuit board. *Double check* to make sure that the transformer and coil leads are in their correct hole, as shown in the illustration. After all leads are pulled reasonably tight through the board and soldered, use a small drop of Krazy Glue™ between the toroid and the board to insure rigidity. Double check the parts layout against the drawing after installation. This will save you from a lot of head scratching later!

Receiver Alignment

This is very simple. You need an accurate receiver (preferably a frequency counter), and a VOM or VTVM. Apply any voltage between 18–24 VDC to the B+ point on the circuit board, and the ground connection to the point labelled "G". Next, confirm that the LO is working correctly and aligned. A frequency counter gives the most accurate frequency calibration. Connect the counter probe to Test Point 1, and the ground lead to

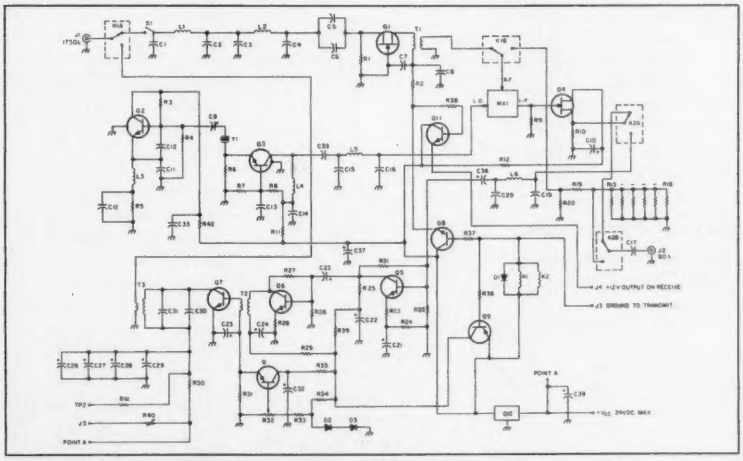

Figure 1. Schematic of the 1750 meter transverter. Note the unusual design of the local oscillator, which greatly attenuates harmonics and oscillator noise.

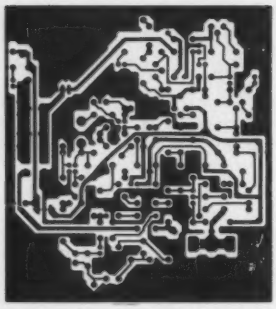

Figure 2. Circuit board positive for the project. Actual dimensions are approximately 4.7" x 4.3".

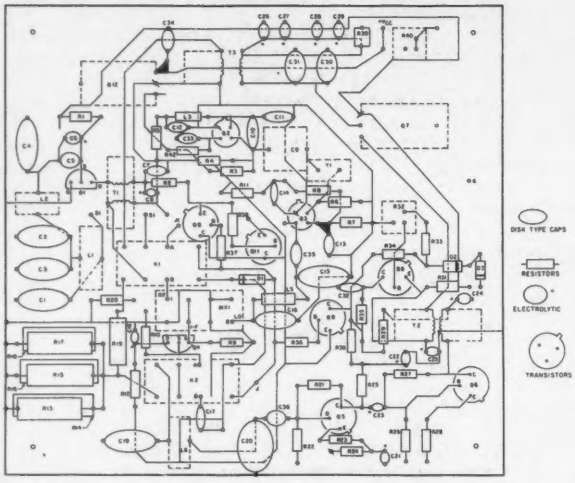

Figure 3. Parts placement for the transverter. A circuit board and parts kit are available. See text for details.

circuit board ground. The frequency should be displayed and C9 adjusted so that a frequency of 3.500 MHz is displayed. This now calibrates the LO.

If a frequency counter is not available, then first calibrate the transceiver as closely as possible to its reference, and tuning to 3.5 MHz. A piece of wire connected from the transceiver RF jack and layed close to the transverter board will pick up the LO signal. Adjust C9 for a zero-beat while watching the S-meter on the transceiver for minimum meter movement. This alternative approach is not as accurate as the first, but done correctly gives excellent results. This completes the alignment for the receive section.

Transmit Calibration

Connect a coaxial line between the transceiver RF jack and transverter 80-meter terminal J1. Place a 50Ω dummy load made of two 100Ω, two-watt resistors connected in parallel to the 1750 terminal J2. This will simulate the 1750 meter antenna during our power test. Get out the VOM or VTVM and connect the red or positive lead to J5, and the black or negative lead to TP2. Adjust the meter so it can be capable of reading 200 mV DC.

Ground point J3 and listen for relays K1 and K2 to change over. With J3 grounded, check the bias of Q7 on the meter and set to 15 mV by adjusting potentiometer R32. The voltage read on the meter is actually the current to Q7, and so 15 mV is really 15 mA of bias current to operate the final stage in Class AB.

Now connect the transmit/receive control point J3 to the transceiver normally-open point on its accessory or transverter plug. Make sure that the common, or other point of the relay in the transceiver, is grounded. Tune the transceiver to 3.675 MHz, which corresponds to 175 kHz. Put the transceiver in Tune mode and listen for transverter relays K1 and K2 to close. Only 10 watts of peak output are needed to drive the transverter to full output, more may over-saturate and damage the transverter.

Set the transceiver to 5 watts of ouput and check the meter connected across points J5 and TP2 of the transverter. It should read a value above 100 mA. Avoid using higher currents beyond 500 mA for more than a few seconds. Adjust the output of the transceiver so the current on the meter is within the legal limits. For example, if the power supply voltage is 24 volts, and the meter current is 100 mA, the peak-to-peak input power is 2.4 watts (24 x.1). This is just under the maximum legal input because 2.4 watts PEP is just under 1 watt RMS (2.4/2 x.707 = .848 watts) DC input power.

The 50Ω dummy load should feel warm to the touch, indicating output power. The voltage can be measured between TP2 and ground for easy calculation of the input power. Return to the receive mode, and remove the dummy load.

The Antenna System

The transverter is now ready to be connected to the antenna system. Often separate antennas are used for transmission and reception. A long and high transmitting antenna may not be the best receive antenna, especially when used in urban or even suburban environments where noise radiating from power lines and neighbors' light dimmers can be obtrusive. The name of the game is to achieve the best signal-to-noise ratio possible. and the best way to do this at the receive end is to use some stategy in choosing and locating a receive antenna.

Two Good Receive Antennas

The Loop antenna has been around for ages and there are many articles covering its proper design and application. In my location, I would be helpless without using one of these for reception, since the high level of power line hash can be easily nulled out. The loop is made of 30 conductor computer ribbon cable with the wires at each end stagger-soldered to produce one continuous electrical path. This is tuned easily with a standard 365 pF variable capacitor and is preamplified before going to S1 on the transverter. I experimented placing the loop in different parts of the yard and discovered a quiet spot furthest from the power lines and equidistant between two apartments. The loop was planted at this spot and rotated for the deepest null in the noise obtainable. Simpler forms of noise such as light dimmers and pulses can usually be eliminated with the noise-blanking switch on the transceiver while complex noise, such as power line hash, is eliminated better by nulling with a loop or phase cancelling.

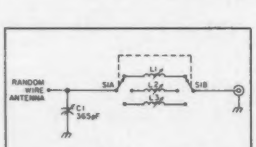

Figure 4. A simple random wire antenna tuner used for reception.

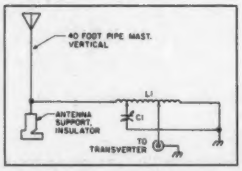

Figure 5. The author uses this antenna configuration, which allows operation on both 160 and 1750 meter bands.

Another effective way to reduce noise is by using an active whip antenna. This is a high impedance, broad-band vertical antenna that is usually around 3' high and has its own preamplifier. It is mounted in a remote location away from power lines and in an area clear of structures. I also use an active whip mainly for general LF listening, and it is mounted on a wood pole at the top of a tree 60' in the air above all the houses and powerlines. I would not receive a tenth of the signals at the base of the tree as I could high in the clear. There are some excellent articles by Ralph Burhans on building or buying active whips, and I highly recommend both the active whip and the broadband active loop. Remember that the location of the antenna, even a few feet, can be the difference between success and failure. Don't let anyone snow you into thinking your loop or active whip will work as well in the garage as it will in the clear part of the backyard. It won't.

Figure 4 shows a simple tuner that works well for general listening using a wire antenna from 50 to 200 feet in length. The coil is selected to resonate the antenna at the desired frequency, using C1 for additional flexibility. Again, erect the antenna as much in the clear as possible.

Good Ground Essential

Another point that cannot be overstated is the importance of a good ground, which is neces-

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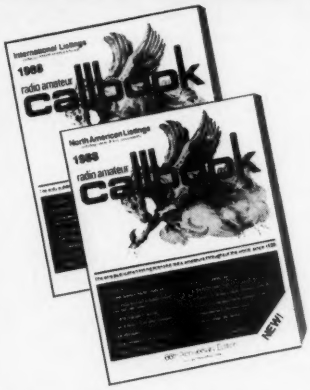

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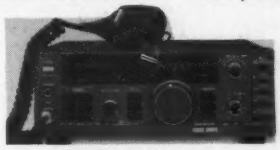

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sary for transmitting efficiently and receiving a lower noise floor. A ground radial system for the transmitting antenna works well and will be discussed in more detail. Ground rods work, but several copper 10' pipes driven into the ground around 10 feet apart and strapped together will outdo a single 3' ground rod.

In areas of rocky, sandy or otherwise poor soil conductivity, it's better to concentrate entirely on a good radial system around the transmitting antenna. Treat the cold water pipe grounding system as a last resort only.

The transmitting antenna I recommend is a vertical antenna with the largest capacity hat possible. In general, a 50' 1750 meter vertical antenna acts much like a 160 or 80 meter mobile antenna, and there is plenty of information in the handbooks to gain a deeper understanding of this similarity. In fairly quiet locations, the transmitting vertical antenna works well for receiving, but limited to the resonant frequency of the antenna. By following a few simple tips, a good transmitting antenna can overcome even the worst locations. Keep the vertical antenna in a primarily clear area away from trees and structures. This type of antenna has a very high Q and becomes sensitive to nearby objects.

The largest ground plane possible should consist of as many wires as practical, starting from the antenna base and laid outward in a radial fashion, which contributes greatly to a strong signal.

It is not necessary for the radials to go beyond a length of 60 feet, since a resonant ¼ wave radial at these frequencies is impractical for most uses.

The antenna-loading coil should be wound with eitherLitz wire, or #18 gauge or heavier Formvar™ enameled wire. The coil form should be made of a high, dielectric quality and usually ranges in size around 4 to 8 inches in diameter, and 6 to 8 inches in length. A glass water bottle, large PVC pipe, or several wood dowels mounted in a circle on a wood base that could simulate a large coil form will work quite well. Do not use the black type of PVC pipe or cardboard forms for loading coils as these and similar types can spoil the Q of the coil or fall apart later. Fiberglass resin or liquid Varathan™ work very well for weatherproofing the coil once completed.

Dual Band Antenna

I use a transmitting vertical antenna with an 8' capacity hat and a small loading coil so the antenna can be switched over and also used on 160 meters as a top-loaded current-fed vertical (see Figure 5). The antenna uses a large diameter Coke bottle half-sunk in a concrete block as the base suport insulator. In my particular installation, I use a high-voltage relay to switch the antenna from either 160 or 1750 meters.

The antenna is current fed on 160 meters using a large, air-type variable capacitor, but when switched to 1750 meters, the antenna is connected to the top of the loading coil with the bottom part of the coil grounded to the radial and/or ground system. The coax braid from the transverter coax line is also grounded, while the center conductor is experimentally taped 4 or 5 turns up the coil from the ground end. A small neon bulb like the NE-2 can be held close to the vertical during transmission to indicate resonance at maximum brilliance.

A field strength meter built out of any of the handbook circuits is very effective to indicate resonance. It is easy to accidentally resonate any antenna of this type on a harmonic, which can cause confusion later. One way of telling if this occurs is if there is a large increase in background noise when receiving at frequency. If the noise floor increases and peaks somewhere above the band limit (190 kHz), then C1 in Figure 4 can be added and adjusted to pad the coil down within band limits.

It is much more efficient to use as little capacitance of C1 as possible, and simply means that more turns must be added to L1 to increase the inductance, and bring the vertical antenna to resonance within band limits. If the coil is wound too large, you will notice it will resonate below the band limit (160 kHz). C1 should be disconnected, and turns gradually taken off L1. When the antenna is resonant within the band, a good listen will reveal the activity in your area, and clear frequencies free of carriers and other signals.

"If the 1750 meter band seems tough at first, don't give up!"

Usually, once a clear spot is found, it is used as the transmitting frequency, and final matching of the transmitter to the antenna will happen. Place the transceiver in the "tune" mode and experimentally adjust the coaxial tap point on L1. Using the neon bulb as an indicator, find the best tap point on the coil when the bulb indicates maximum brightness. A more scientific way to find the coaxial tap point is to use a 50Ω simulation.

Connect the 50Ω dummy load, and while transmitting, find the AC voltage or current using an oscilloscope or AC voltmeter or current meter. Once the value has been noted, connect the transmitter to the antenna and adjust the tap point, monitoring the voltage or current at that point and setting the tap point where the voltage or current is the same as the one that was checked across the 50Ω load. This will simulate a 50Ω load at resonance.

The final adjustment is made by adjusting C1 and the tap points on L1 while transmitting a peak indication on the neon bulb or signal strength meter, which coincides with the right value of voltage or current measured at the tap point. Once you do it a few times and gain a "feel" for matching the antenna, it becomes quite simple. It's worth keeping an eye out for RF current meters in the .1 to 1 amp range at swap meets and related ham functions, since they are worth their weight in gold to the experimenter.

Final Thoughts

If the 1750 meter band seems tough at first, don't give up! Working harder to gain an understanding of the way things work on LF has kept me devotedly interested in this band for over 15 years, and the possibilities of what can really be done here is limited only to the imagination. 1750 meters has grown up over the past couple of years thanks to experimenters introducing better circuits and more state-of-the-art equipment.

Full detail on the different aspects of 1750 meter equipment and operating techniques can be found in a number of *The Lowdown*, published by the Long Wave Club of America, 45 Wildflower Rd., Levittown, PA 19057. Membership is $10 per year in the US, and $18 per year overseas. This is worthwhile for general LF activity including 1750 meters, and is published monthly. Another publication that specifically focusses on 1750 meter activity is the *1750 Meter Western Update*, 226 Charles St., Sunnyvale, CA 94086. This is a monthly newsletter and can be obtained by sending 12 business-size, SASE (22-cent) envelopes to the above address, with a donation for copy costs for a full year of issues.

Some specific issues for further information about receiving and antennas is the June 1985, May 1985 and March 1987 *Lowdown* issues featuring circuits by Ralph Burhans and Mitchell Lee on active broadband loop receive antennas.

Ralp Burhan has details of various 1750 meter accessories available by writing: Ralph Burhan, 161 Grosvenor St., Athens, OH 45701.

The transverter shown in this article is available in kit form and includes all parts, circuit board, and instructions from Seden Communications, 1272 Harold Ave., Simi Valley, CA 93065. Also available from Seden Communication is the 1750-meter antenna loading coil and other related items. Call (805) 583-5687 or write for prices and more details.

The Southern California SSB Net meets every Saturday morning at 10 AM local time on upper sideband on 182 kHz. We welcome local response.

David Curry is an avid Lowfer and holds a General class license. He can be reached at 4415 Cahuenga Blvd., Toluca Lake, CA 91602.

Continued on page 53

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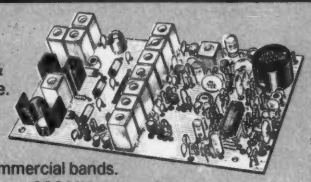

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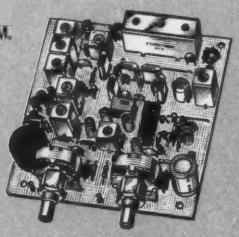

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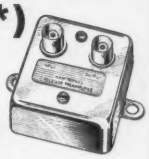

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Specifications

General
- Frequency Coverage: Any two 50 KHz segments in the 28.0–29.0 MHz Amateur Band (28.25–28.30 and 28.30–28.35 MHz supplied)
- Frequency Control: VXO provides 50 KHz of continuous tuning with a single crystal
- Frequency Stability: Within ±500 Hz from a cold start
- Antenna: 50 Ohms Unbalanced, BNC connector
- Power Requirement: 8.4–9.0 VDC
  (Included): 6-AA Dry Cells (1.5 volt/cell) = 9.0 VDC
  (Optional): 7-AA NiCads (1.2 Volt/cell) = 8.4 VDC
- Current Drain: Receiving - Approx. 70 mA
  Transmitting - Approx. 620 mA
- Dimensions: (W) 66mm × (H) 39mm × (D) 142mm
- Weight: 710 Grams (1 lb. 9 oz.) with batteries and antenna

Transmitter
- Output Power: 2 Watts at 9.0 VDC
- Emission modes: A3J (USB) and A1 (CW)
- Spurious Emissions: More than 40 dB down

Receiver
- Sensitivity: less than 0.5 uV for 15 dB S/N
- Intermediate Frequency: 11.2735 MHz

Controls and Indicators
- On/Off Volume control Top mounted Potentiometer
- Receiver Incremental Tuning (RIT): Top mounted Potentiometer with center off detent position
- Frequency: Top mounted 50 KHz VXO
- Frequency Range: Top mounted 2-position switch
- Noise Blanker: Top mounted On/Off switch
- S/RF meter: Top mounted S/RF meter
- Built in CW key: Top mounted momentary switch
- External Speaker output: Top mounted 1/16" phone jack
- External Microphone input: Top mounted 1/8" phone jack
- Antenna Connector: Top mounted Female BNC
- Transmit Indicator: Top mounted Transmit LED
- Push-To-Talk: Side mounted momentary switch
- External Power: Bottom mounted 2.1 mm coaxial
- External key input: Bottom mounted 1/8" phone jack
- Mode Selector Switch: Bottom mounted 2-position switch
- Charge/External Power: Bottom mounted 2-position switch selecting 12 VDC external power function

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NAME	CALL	QTH	CONTACTS	SCORE
1. Gerard Bellamy	WA7HLC	Conway, SC	42	4432
2. Dave Hallidy	KD5RO	Plano, TX	25	1625
3. Louis A. Poche	KD5XE	New Orleans, LA	15	525

CALL	SCORE
4.KB5VC	260
5. N5FTT	240
6. KA5TTL	240
7. N5GWF	240
8. KA5UAI	240
9. N5HML	240
10. KB5XZ	240
11. KA5QLC	240
12. WA6GDF	160
13. KJ4BF	140
14. W6YLL	129
15. N3ELM	120
16. WB4WXE	120
17. N8INX	120
18. WA5ZIB	100
19. N5FUW	100
20. KA5CSI	100
21. KB6JIY	91
22. WA4OWC	75
23. KU6U	71
24. WB4YLR	60
25. NY0T	60
26. K7RDH	50
27. KD8RC	50
28. N5IUF	50
29. KG6MW	47
30. WA2HUF	45
31. WB8HFZ	45
32. N7AQM	41
33. KB9SH	40
34. WA4FQT	40
35. WA2VWG	37
36. WA6BVN	37
37. KB8AER	35
38. W7FBV	35
39. K6MBN	30
40. W7KXB	25
41. W4NJK	24
42. WA8VSY	23
43. KA7UBC	23
44. KB7ACP	22
45. W9HJM	20
46. W6GTZ	20
47. WP4FWT	20

CALL	SCORE
48. WB5CHV	20
49. KE5O	20
50. WB2JHG	20
51. KA3LLQ	20
52. KA9YVZ	20
53. WB7SLY	16
54. KA8JQW/8	15
55. N8AXA	15
56. KA8JQX/8	15
57. K5JT	15
58. WA2SNQ	15
59. K8BL	15
60. NF8K	15
61. WA5YKO	11
62. WB5FWE	10
63. WB5RMA	10
64. VE3CK	10
65. KA2PES	10
66. N2DF	10
67. VE3KRP	10
68. K3SDL	10
69. WD8MYN	10
70. WB7UNU	10
71. KI6PL	10
72. KB6MPJ	10
73. WB0YFL	10
74. KA0NFW	10
75. WB0JIU	10
76. K8VEX	10
77. KE6JC	10
78. WB5NGC	10
79. N2HEQ	10
80. VE3CX	10
81. N2GKM	5
82. WB2JXY	5
83. WB2TVX	5
84. K2AWA	5
85. WB6GWW	5
86. N9HH	5
87. N0IS	5
88. WA9CAT	5
89. KA4TUT	5
90. WB8VYW	5
91. WB8LCD	5

CALL	SCORE
92. WB2OEB	5
93. N2GRT	5
94. KA7VNO	5
95. AD7I	5
96. WB1FVS	5
97. K9LL	5
98. K1POP	5
99. WA9FIH	5
100. KB4ZHM	5
101. KB4ZHL	5
102. WL7AZB	5
103. KB4ZFA	5
104. KB4ZHE	5
105. N8FVG	5

CALL	SCORE
106. WD4MWQ	5
107. N4MOP	5
108. WZ4K	5
109. KA5VBL	5
110. KA5UOA	5
111. KA5TQY	5
112. AJ9K	5
113. KA5ROZ	5
114. WA7JUO	5
115. KB8DBK	5
116. NA1O	5
117. W9GXR	5
118. WA5OSD	5

Other Participants

KA8TIL	WA4WSS	KA1IYN
AD0V	N6JXI	W5UA
N4OSD	KA7YOU	KB4VPN
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NT8M	KA9UCE	WA6ARA
KA3BOZ	W9MVP	KB6TIU
KF6QB	WAIXIH	WG4N
WB5EVF	KB8APK	KY3F
NS5N	N8IJW	KB6ONO
N7BZD	N8HAM	WB0VCC
KA7OKJ	KA2BPP	KA7WRP
KK5D	K2FH	WB9WVK
KD2GC	KB6RBY	KD9PR
N9DKC	KB6RBX	WV5F
N8HVQ	WA8QAA	W6ORS
N0ICK	WA8UXL	KA5ZIF
K4FHQ	N0HPJ	W7XU
WL7BKW	KA9MGD	KC3CF
KB5DFY	N3FJQ	WB8FWE
N4PKR	W5SSB	KB8S
N2FQM	KB5AUM	WD5H
KC4AQC	WB2CZC	KA3QJY
N0FMR	NM2I	KA0RRL
K4KCC	N4ACS	
WB5IKO	N5JJY	

The Micro-20 Receiver

Advanced technology makes this superhet a snap.

Rick Littlefield K1BQT

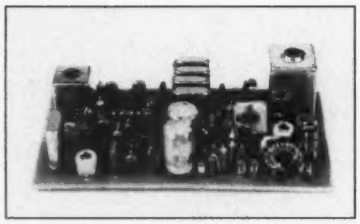
In the past, designing QRP rigs usually meant agonizing between direct-conversion simplicity and superhet performance. Fortunately, recent advances in receiver technology now enable us to build full-featured superhets in DC-simple packages. Here are three reasons why.

The first is the Signetics NE602 mixer IC. This inexpensive device combines a double-balanced mixer, local oscillator, and bias network on one 8-pin chip.[1] Although designed for VHF compandered sideband applications, the NE602 is a natural for amateur projects, since it requires few external parts, works well as a mixer or product detector, and provides up to 20-dB of conversion gain at HF frequencies.[2]

Another important innovation is the recent application of Cohn filters to SSB IF strips.[3] First described by Wes Hayward, this technique enables amateurs to tailor-made bandpass filters from inexpensive surplus crystals. This provides builders with an extremely attractive alternative to purchasing expensive sealed commercial units.

Finally, the increased availability of monolithic capacitors and other sub-miniature parts with .1″ lead spacing allows designers to make PC layouts smaller—without overcrowding.

The receiver described in this article incorporates all three of these advances onto a single 1⅝″ x 3″ board. The circuitry employs four inexpensive ICs, two transistors, five surplus crystals, and a small handful of parts. Yet, sensitivity is well below the noise-floor of the 20-meter band, stability is excellent, selectivity is very respectable for a four-pole filter, and audio-derived AGC holds listening levels constant over a wide range of signals. In short, the receiver delivers the kind of performance that makes QRP operation truly enjoyable.



The Micro-20 Receiver

Circuit Description

This particular radio employs a traditional 9-MHz IF, 5-MHz VFO mixing scheme (see Figure 1). Many other IF/VFO combinations are possible by adjusting the tuned circuit values accordingly.

A double-tuned bandpass filter at L1-L2 pre-selects 14 MHz signals prior to mixing by U1. VFO injection is provided by the NE602's on-board oscillator. Frequency is determined by a Colpitts tank circuit L3, C7–C10. An optional "fine-tune" control is provided by R21, which functions as a small variable capacitor when connected as shown. The value of C34 sets the tuning range of R21.

The 9 MHz output of U1 is filtered by a four-pole Cohn crystal bandpass filter. Since CW operation was desired, values for C12-C16 are selected to provide a −3-dB bandwidth of about 1.0 kHz (reducing these values broadens filter response, permitting comfortable SSB reception).

IF amplifier U2 provides up to 50 dB of gain, with an AGC range of nearly 70 dB. T1 tunes the IF output and matches it to the signal port of product detector U3. U3's on-board oscillator is crystal-controlled to insure LO frequency stability. C23 nets Y5 to the desired BFO frequency. Audio output from U3 is rolled off by R7, C27 to help reduce wideband amplifier noise and high-frequency QRM.

The audio amplifier and AGC system have been described in a previous article.[4] Audio amplifier U4 delivers about 200 mW of pow-

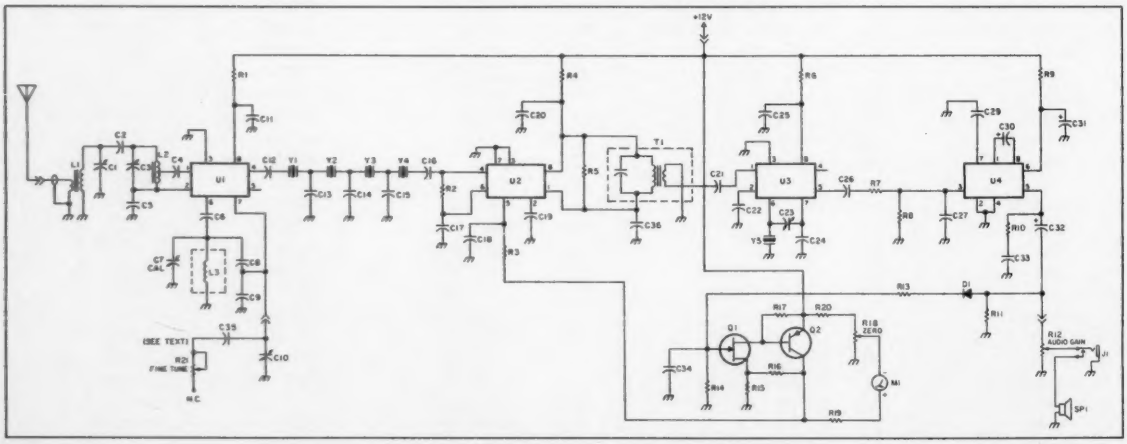


Fig. 1. Schematic diagram of the 20 meter micro receiver module.

er—enough to drive a small speaker or headphones. Since U4 is located within the AGC loop, it runs at maximum gain and relies on the AGC system to limit its output to a nominal level. R12, an attenuator, is located outside the AGC loop, and functions as a volume control for speaker or headphones. R11 insures that the output stage of U4 remains properly loaded when the speaker is disconnected or when high-Z phones are used.

AGC detector D1 samples U4's average output level, and sends a rectified control voltage to DC-amplifier Q1. C34 and R14 establish the AGC system time constant. Q2 drives the S-meter and AGC line. A quiescent output of 4.5–5 V (set by R16) holds AGC voltage just below U2's threshold until a signal appears. Voltage divider R18 zeros M1 by equalizing Q2's quiescent voltage at the negative meter terminal.

Crystal Selection

A close crystal match in resonant frequency determines how well the Cohn bandpass filter will work. Wes Hayward suggests holding frequency differences to within 10% of the desired filter bandwidth. This means a group of crystals selected for a 500-Hz filter should resonate within 50 Hz of each other, and crystals for a 2.7-Hz filter should resonate within 270 Hz of each other. I characterize crystals by hooking them into a simple test oscillator and reading the frequency of oscillation on a counter or digital-readout receiver (Figure 2). This enables me to select the right group of crystals for the particular filter I am building.

Construction

The board layout assumes .1" lead spacing for most components, so the first task is to select small parts. All resistors are ¼ watt and end-mounted. Bypass and frequency-critical capacitors should be either 50-volt monolithics, or low-voltage NPO disc ceramics. Small 100-volt silver-mica capacitors are preferred for C12–C16, but high-quality NPO discs may work nearly as well. The ¼" plastic form for L3 is a popular surplus item that has been stripped and rewound with #32 wire. If you have difficulty locating components, there are PC boards and a complete parts kit available from Radiokit, Box 973, Pelham NH 03076.

Mounting and soldering miniature components is really quite easy—if you use the right tools for the job. I prefer a 700° temperature-controlled soldering iron with a fine chisel tip. Keep a damp sponge handy for cleaning the tip. Hemostats, a sharp hobby knife, nippy-cutters, and a vacuum de-soldering tool are all extremely useful tools. A board vice and magnifier lamp are optional, but nice to have.

Refer to Figure 3a for parts placement and lead locations. It may be easier to wind VFO coil L3 after the coil form has been mounted on the board. Be sure to secure windings with a coat of clear nail polish before installing the shield can. As you populate the board, double-check component polarities and IC placement-keys before soldering in place. Figure 3b shows a bottom view of the board. Two jumpers and a bus-wire lead for C10 must be installed on this side. When construction is complete, it is good practice to clean the foil side of the board with flux stripper and inspect it for solder bridges or cold joints.

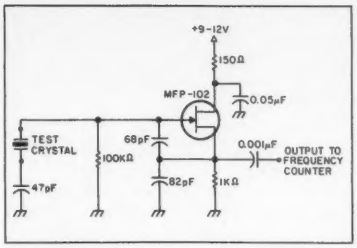


Fig. 2. Test oscillator for characterizing surplus crystals.

Mounting the module is not critical, but follow the usual precautions to insure VFO stability. My receiver is mounted in a Ten-Tec TG-series box, and plenty of additional space is available for a battery pack or companion QRP transmitter. Figure 4 shows module wiring.

Testing and Alignment

Once wiring is complete, apply 12 volts from a regulated supply—and check for smoke. A faint hiss from the speaker indicates working audio circuitry. Here is the recommended alignment procedure:

1. Zero the S-meter by adjusting R18.
2. Check the quiescent AGC voltage at the top of R16 to confirm that it is between 4.5 and 5 volts. If the reading is out of that range, substitute a different value for R16.
3. Check U3 for BFO oscillation. You should hear a shift in speaker noise as you adjust C23. Set the BFO frequency 1.5 kHz below the filter's center frequency (8998.5 kHz).
4. Peak the slug in IF transformer T1 for maximum noise. Note that C36 lowers the resonant frequency of T1 slightly, to insure that it will peak at 9 MHz.
5. Check the VFO for oscillation with a scope, frequency counter (Hi-Z probe on pin 7), or general coverage receiver. Receiving frequency is determined by adding the VFO frequency to the IF frequency (9000 + 5.250 = 14.250, etc.). Calibration control C7 provides some frequency adjustment, but large corrections may involve removing turns from L3 to raise frequency, or adding capacitance across C7 to lower frequency. Tuning range will be around 150 kHz with a 50-pF variable at C10.
6. Once both oscillators are functioning properly, connect a 20-meter antenna and adjust C1 and C3 for maximum sensitivity. Two distinct peaks per revolution indicate that each tuned circuit is resonating properly. The NE602 mixer has a very low noise figure, and the receiver has plenty of gain. Consequently, connecting and disconnecting the antenna should produce a marked change in the background noise level.
7. Check AGC action by tuning across a strong sideband or CW signal. The S-meter should deflect to nearly full scale, and audio should be undistorted and free of obvious pumping (overdriven AGC) or cracking (under-driven AGC). If one of these conditions is noted, changing the value of R13 will adjust AGC drive. If your meter movement is more or less than 200-μA, change R19 to provide the proper range of deflection.

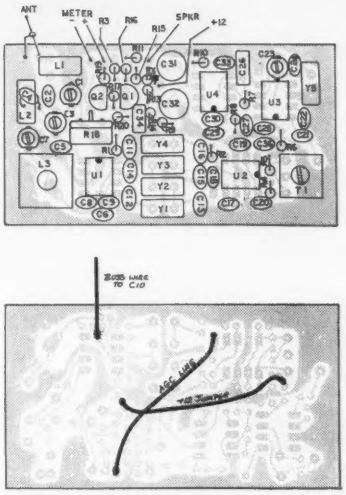


Fig. 3. Parts layout of the receiver. Top (3a) and bottom (3b) view.

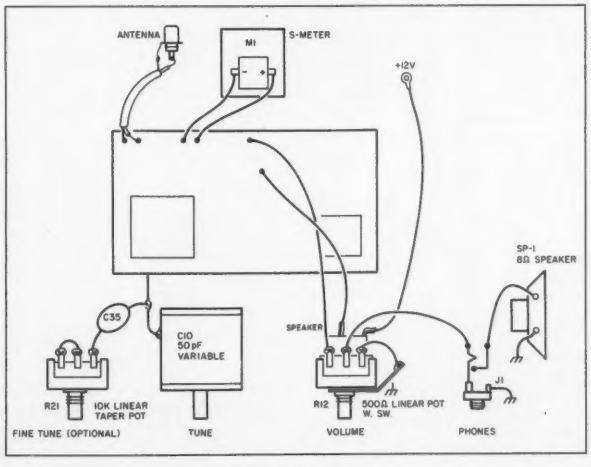


Fig. 4. Module connections.

8. Check the response of your crystal filter by tuning across a heterodyne. As you tune through zero beat, the opposite sideband should be much weaker or barely audible. Excessive ripple, indicated by exaggerated up-and-down S-meter movement when tuning through the desired sideband, may indicate improper filter termination. Shallow skirts may mean one or more of the crystals are too far off the filter's design frequency.

When choosing a power supply, note that the IF/AGC circuitry is voltage sensitive. The voltage source should be regulated to between 11.5 and 12.5 volts. Significant departure from this range will deteriorate receiver performance.

Options

Here are some possibilities for modifying or adapting the design.

1. For optimal SSB reception, reduce C12-16 to 68-pF, and increase R2 to 820-Ω.
2. Changing pre-selector filter value for resonance at 3.5–4.0 MHz region will permit 80-meter operation. However, for LSB reception, BFO frequency must be shifted to 9001.5 kHz.
3. If 9-MHz region will fall within the tuning range of IF transformer T1. IF frequencies as low as 8 MHz may be used by increasing the value of C36. VFO L and C values must be adjusted accordingly. Also, 3.579-MHz color-burst crystals may be used, if T1 is replaced with a lower-frequency LC circuit.
4. One immediate disadvantage of the NE602 on-board oscillator is the lack of a buffered output to drive a transmit mixer. However, transceiver frequency control may still be possible. A 200-mV oscillator signal (emitter level) can be picked up at pin 7. This is sufficient to drive a simple external FET buffer (Figure 5).

Conclusion

Recent innovations like the NE602, simple Cohn IF bandpass filters, and the availability of sub-miniature parts make "bare-bones" superhets an increasingly attractive alternative to direct conversion. Building a QRP rig takes time and money no matter which way you go. So, why compromise performance when you can have the best?

References

(1) "SA/NE602 Double-balanced Mixer and Oscillator," Linear Products Group, Signetics Corporation, September, 1985.
(2) "Build a Pocket-portable SSB Receiver," Klinert, Ham Radio, November, 1986.
(3) "Designing and Building Simple Crystal Filters," Hayward, QST, July, 1987.
(4) "Compact 20-meter CW Travelradio," Littlefield, Ham Radio, June, 1987.

Rick Littlefield K1BQT got his ticket at 13 in 1957. Now he's an Extra and publishes in many major amateur publications including CQ Ham Radio *(Japan). His forte is building compact QRP equipment.*

Rick is a professional writer/producer for video training materials and owner of Omnicom Productions in Barrington NH. He can be reached at Box 114, Barrington, NH 03825

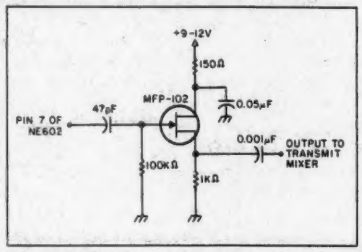


Fig. 5. Buffer circuit. This allows the NE602 on-board oscillator to drive other stages such as a transit mixer.

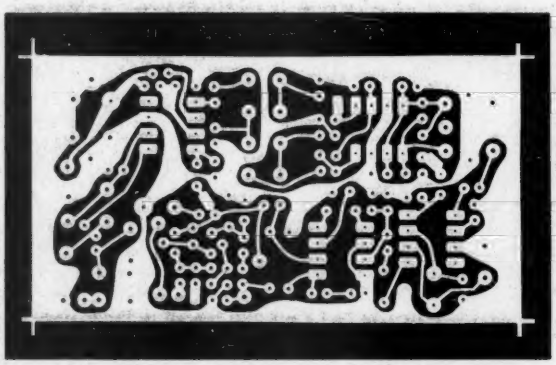


Figure 6. Printed circuit board negative for the 20 meter receiver.

Parts List

Semiconductors:

U1, U3	NE602 double-balanced mixer IC
U2	MC1350P IF amplifier IC
U4	LM386 400-mW audio amplifier IC
Q1	MPF-102 J-FET
Q2	2N3906 PNP
D1	1N914 switching diode

Crystals:

Y1–Y5	9000 kHz, .001% series resonant, .2" spacing.

Inductors:

L1	22 turns #26 on T37-2, 2-turn link on cold end.
L2	22 turns #26 on T37-2, center-tapped.
L3	38 turns #32 on ¼" form, no slug, 13mm shield can.
T1	10.7 MHz IF transformer, 10mm, green core.

Capacitors:

C1, C3, C23	60-pF trimmer
C2, C34	4.7-pF, 50-volt NPO
C4, C21	.001-μF, 50-volt monolithic
C5, C6, C11, C17, C19, C20, C22, C25, C29, C33	.1-μF, 50-volt monolithic
C7	8-pF NPO trimmer
C8, C9	330-pF, 50-volt NPO
C10	50-pF variable, 6:1 reduction drive
C12–C16 (5)	100-pF, 100-volt silver mica (see text)
C18	.01-μF, 50-volt monolithic
C24	47-pF, 50-volt NPO
C26, C34	1-μF, 50-volt monolithic
C27	.068-μF, 50-volt monolithic
C30	10-μF, 16-volt tantalum dip
C31, C32	100-μF, 12-volt electrolytic
C36	15-pF, 50-volt NPO

Resistors:

R1, R6, R7	1.8kΩ, ¼W
R2	680Ω, ¼W (see text)
R3, R5, R13, R17	10kΩ, ¼W
R4	100Ω, ¼W
R8	47kΩ, ¼W
R9	22Ω, ¼W
R10, R11	15Ω, ¼W
R12	500Ω linear pot with off/on switch
R14	2.2MΩ, ¼W
R15	1kΩ, ¼W
R16	3.9kΩ, ¼W
R18	20kΩ miniature trim-pot
R19	3.3kΩ, ¼W
R20	1kΩ, ¼W
R21	10kΩ linear pot

Miscellaneous:

M1	200 μA S-meter
SP1	2¼" or 3", 8Ω Speaker
J1	⅛" closed circuit phone jack

Optional Fine Tune Circuit:

R20	10kΩ linear pot.
C35	4.7-μF, 50-volt NPO

1750m
THE EXPERIMENTERS BAND

Here's How to Dabble on 160—190 kHz

by Ken Cornell W2IMB

Tired of the 20m SSB crowd? Hate contest weekends? Have a hankering to build a simple transmitter? Want a real challenge? C'mon down to the low frequency (LF) band and join the fun, and you can leave your ham license behind!

It's a great big world out there! All hams know about Part 97 of FCC Rules and Regulations, which governs licensed amateur operations. Most have yet to discover the great fun that Part 15 allows, although some may recognize this section covers the use of nonlicensed transmitting devices.

In Subpart D, Section 15:112, they permit the operation of a radio transmitter as follows:

(a) The power input to the final radio frequency stage (exclusive of filament or heater power) does not exceed one watt.

(b) All emissions below 160 kHz or above 190 kHz are suppressed 20 dB below the unmodulated carrier.

(c) The total length of the transmission line and antenna does not exceed 15 meters.

Any type of transmission mode can be used with the exception of Class B (damped waves).

Let me tell you, 1750m can rejuvenate that radio experimenter's spirit so many hams find fading these days. QRPoperations at 160 kHz are like no other ham experience. It's a challenge, allright, and a heck of a lot of fun.

Who Uses 1750m?

The 1750m band was a "sleeper" until the late 1960s when small groups of experimenters, mainly hams, began to operate on it. They call themselves "Lowfers," short for Low Frequency Experimental Radio Station. Lowfers make up their own calls. The rules allow use of any callsign unless it belongs to an authorized station, including those in the amateur radio service.

Initially, small groups clustered in the Northeast and on the West Coast. They ran beacons and used the 160m and 75m phone bands as back-up communications. Contacts over more than 100 mile were considered real DX! Vast improvements since then in antennas, transmitting, and especially receiving techniques, led to reception reports over 2000 miles away.

Make no mistake, 1750m presents some serious challenges for the experimenter. These require strategy to overcome, and those with successful strategies reap the rewards of true radio pioneers. Take a look at some of the common problems of LF and how to get around them.

The high noise level in LF is the worst problem. Unfortunately, most of this noise is man-made. Appliances, light dimmers, and power lines are common sources. Some of the noise comes in on power line feeds into the home.

Assuming a good, efficient receiver, first sort out all the possible noise sources within the home. A good power mains filter will help reduce imported noise. Running the receiver on battery power is better still. Flourescent lights are noisy and can cause serious trouble if located in the shack. Schedule appliance use as much as possible around your operating schedule.

About Antennas & Transmitter

Avoid automatically slinging up the highest and longest wire antenna possible. Depending on the location, it may be a terrific noise collector! Try, instead, to achieve the best signal-to-noise ratio (S/N) possible.

An active antenna may help for a noisy location. This is a relatively short whip mounted on a weathertight housing that contains a broadband preamplifier. Use coax to connect it to the receiver and power source through an isolating network. This type of antenna is small and easy to mount and can be moved around the average home to find the best S/N location.

Another popular antenna is the loop type. They come in various designs, but they all have the classic "figure 8" pattern. Use the nulls off the sides to attenuate a noise source.

The transmitting antenna should be vertical and located in as clear an area as possible to avoid RF-absorbing structures and trees. Use a good ground system. Lay as many radials as possible on the ground around the antenna.

Try to get an antenna configuration that fits into an imaginary cylinder 15 meters high by 15 meters in diameter, to take maximum advantage of the legal size. The transmitter should be within, or at the periphery, of the circle. Despite the low power, high RF voltage will be on the antenna, so all supports should be extremely well insulated.

Practically all Lowfers today use solid-state transmitters. Most of the popular designs use high frequency crystals with ICs that divide the frequency to come out at the desired frequency. Most use power FETs, such as the IRF series or the VN types, as a final amplifier. When using ICs, the only coil normally required is the antenna loading/coupling coil. This coil should have a high "Q." Most Lowfers use Litz wire for the coil.

Information Sources

Palomar Engineers (Box 455, Escondido, CA 92025) market a number of receiving accessories for LF, including loop antennas and a VLF converter to receive 10–500 kHz on a standard shortwave receiver. An excellent source of transmitting and receiving hardware is LF Engineering (17 Jeffry Road, East Haven, CT 06512) founded by Sal DeFrancesco K1RGO. LF Engineering publishes a sizeable catalog of receive converters, preamplifiers, antennas, a transmitter, and miscellaneous accessories. Their catalog also provides some useful engineering information on operating in the 1750m band.

The Longwave Club of America publishes The Lowdown, essential reading for Lowfers. The monthly bulletin shares readers' experiences, prints projects, and covers LF propagation.

It is available for $12 per year from LWCA, 45 Wildflower Road, Levittown, PA 19057.

On the Air is published by Brice Anderson and is a useful source for a list of active Lowfers and their operating schedules. Write to Brice at Box 14, Lancaster, PA 62855. Hal Murken (19 Hobby Lane, Oakland, NJ 07436) publishes The Lowfer Letter, an excellent forum for LF DXers. The Western Update lists beacons and includes construction projects and other information of interest to Lowfers. Write to Jim Ericson, 226 Charles Street, Sunnyvale, CA 94086. Send business-sized 22 cent SASEs for these publications.

There are more than 100 known Lowfers—plenty of room for more! Here's a chance to really have some fun running QRP in an area where radio started, and it doesn't even require a license! For the circuit builder, antenna experimenter, or just the serious listener, the challenge of "lowfing" could really add the spark of inspiration that's missing from a lot of hams' hobby lives. Give it a shot. See you down the log!

73 Review *by Larry Ledlow, Jr. NA5E*

Ludvigson Tonegen

A Service-Oriented Tone Generator for the Commodore 64

Ludvigson Electronics
415 N. Duluth
Sioux Falls SD 57104
Price Class: $12.95

Hams and other electronics hobbyists often find themselves in need of major test equipment. Most electronic service and test equipment carries a price tag well above what most individuals and clubs care to shell out, especially for part-time work. After all, why spend thousands of dollars on equipment needed only occasionally? Equipment rental is a solution, but Dave Ludvigson has an even better one.

The Ludvigson Tonegen software for the Commodore 64 goes a long way towards meeting a lot of maintenance needs. When coupled with an additional, easily built hardware interface—not supplied—a Commodore 64 turns into a very versatile piece of test equipment. Table 1 lists all of the functions Tonegen software provides. The signaling, function generation, and lookup tables can serve any number of purposes, but repeater enthusiasts should find this software especially useful.

For field service, Ludvigson also sells a Porta-Pow'r-Pak converter that will power a C64 from 12 VDC.

No fancy graphics here, just straightforward menus. Tonegen is a basic, disk-based program that will satisfy a lot of complex service needs. Besides, the price is right.

Although the hardware interface is not difficult to build, I suspect many more people would rather purchase a complete hardware/software package for a little more money. I can only recommend that as an improvement.

TONEGEN performs the following functions:

A. Monotone signalling from 0 to 3950 Hz.

B. Triangle, square, and sawtooth wave forms.

C. Two-tone sequential encoding, with user-definable time duration.

D. 12-Key DTMF encoding, using a string of up to forty digits.

E. Digital dialing, using 400, 1000, or 2805 Hz.

F. Sweep generator operation.

G. Color bars and other video outputs.

H. Motorola capcode to two-tone sequential frequency conversion.

I. CTSS code to frequency look-up table.

J. Effective radiated power calculations.

K. Self-contained user's manual.

The TONEGEN Hardware Interface

The circuit on right is all that is necessary to utilize TONEGEN to its full capacity. Construction methods are not critical—use the PC board layout (Fig 1.) or perfboard. Note that the majority of this circuit is used to pulse the digital dialing relay via the user port. If you don't plan on using digital dialing, or if you just want to play with TONEGEN in a hurry, simply wire up the bottom half of the schematic. This will provide all of the tone functions.

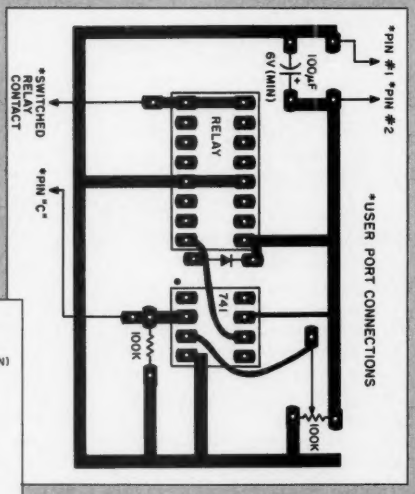


Fig. 1. PC board layout for the audio/video port interface.

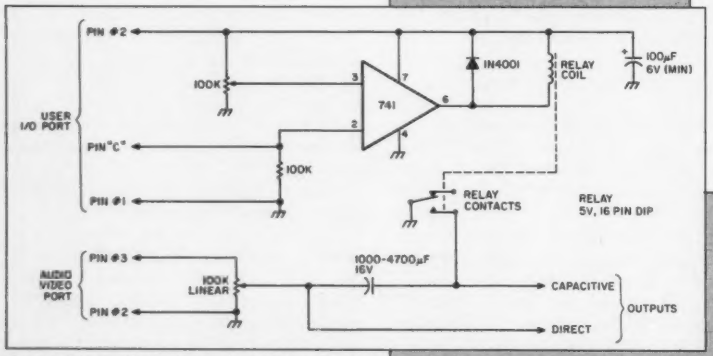


Fig. 2. Schematic for the audio/video port interface. Ludvigson does not supply this interface.

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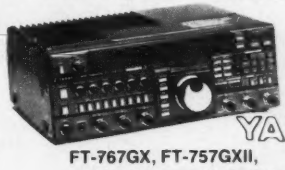

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Tempo M-1

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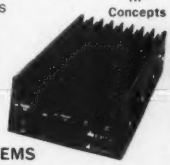
RF Concepts



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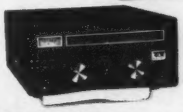

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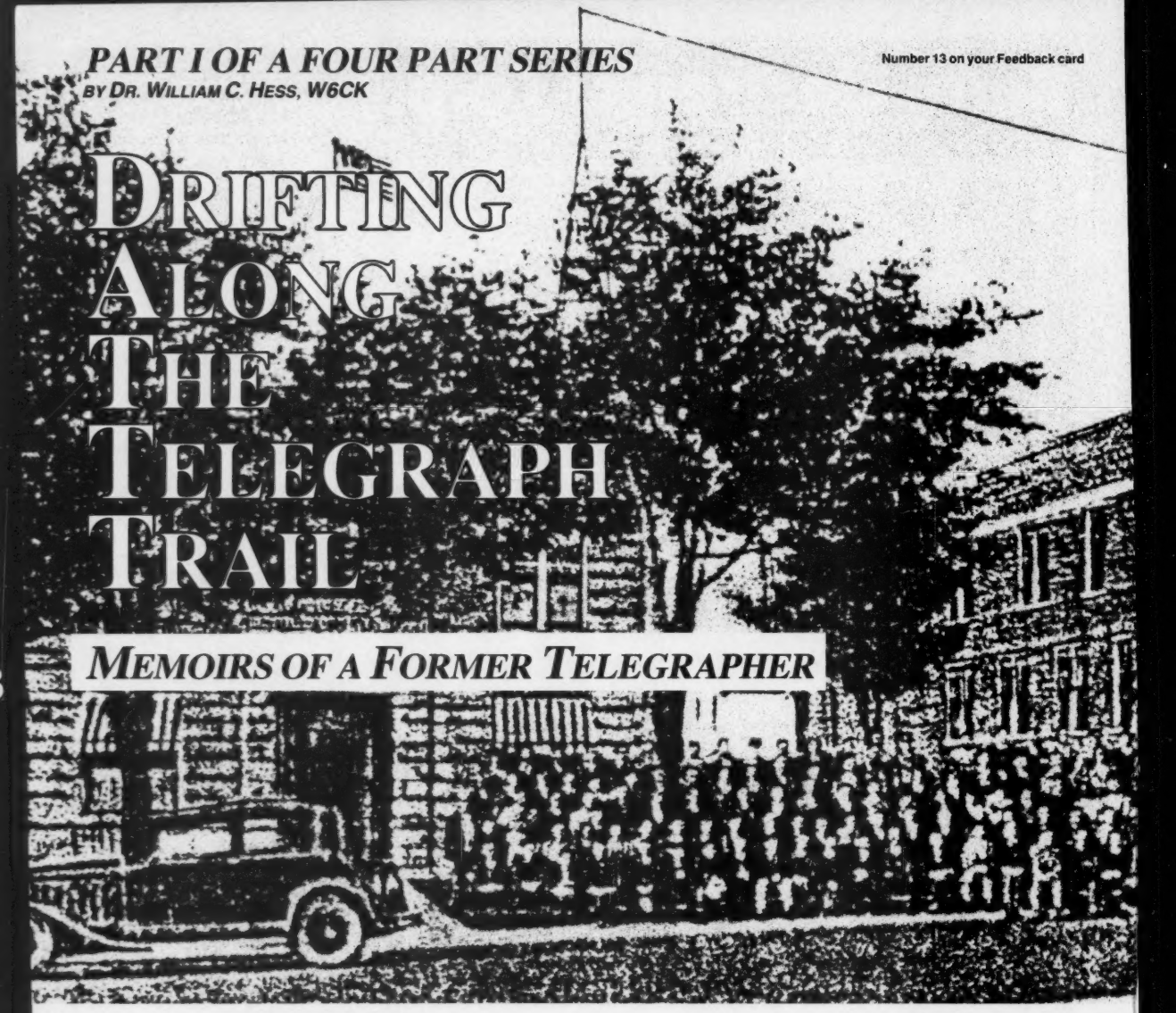

Stop him!" was the command I received from Western Union's wire chief at Fargo, North Dakota, on an August evening in 1945. I had copied telegrams for more than two hours from the Great Northern Railway's station agent at Michigan City, North Dakota. These messages were, of course, sent via landline telegraph in American Morse code.

I immediately opened the switch on my Ultimate brand bug. This caused the telegraph circuit to open to "MC" (the telegraph call sign for Michigan City). The MC operator could not send any more until I reclosed the switch on my bug.

The Wire Chief asked me, "How did you get into a mess like this?". "Just lucky, I guess," was my reply.

"Great balls of fire," exclaimed the WC, "Ask him how damn many more messages he has." When the reply came back, "A stack six inches high," the WC said to me, "Tell him to stand by; I'm going to cut him through to Minneapolis."

In those days, telegraph operators throughout the whole state of North Dakota could light the red pilot lights of all eighteen telegraph circuits tied into the Fargo office of Western Union. During evening hours, by sending the right combination of long dashes, telegraph operators could cause selective relays to turn on the red lights tied into the Fargo office. Three Fargo telegraphers took turns answering these lights by plugging into the proper jack. Usually, each calling station sent only one or two telegrams.

When an operator had finished copying from a station, he could return to the north end of the long Western Union traffic room. We three operators spent our time there when we were not busy copying North Dakota's messages—telling stories and lying to each other about how many months it had been since we had *broken*. To break, in American Morse telegraphy, means breaking the circuit by opening the key switch to ask the sending operator to repeat a word. It is a matter of great personal pride for any telegraph operator to be able to copy for a long time without breaking, whether one is a landline or a radiotelegraph operator.

Commercial telegraph operators often used the code eight hours a day, seven days a week. With the passage of years, code became as natural as the English language so that, indeed, weeks or months could pass without the necessity of a break.

In my case, I received thirteen hours a day of code practice. I worked an eight-hour shift during the daytime for the Great Northern Railway. Each evening I reported at 7 PM to the Fargo Western Union office for an additional five-hour shift. The telegraphy trade refers to such moonlighting as scoop-

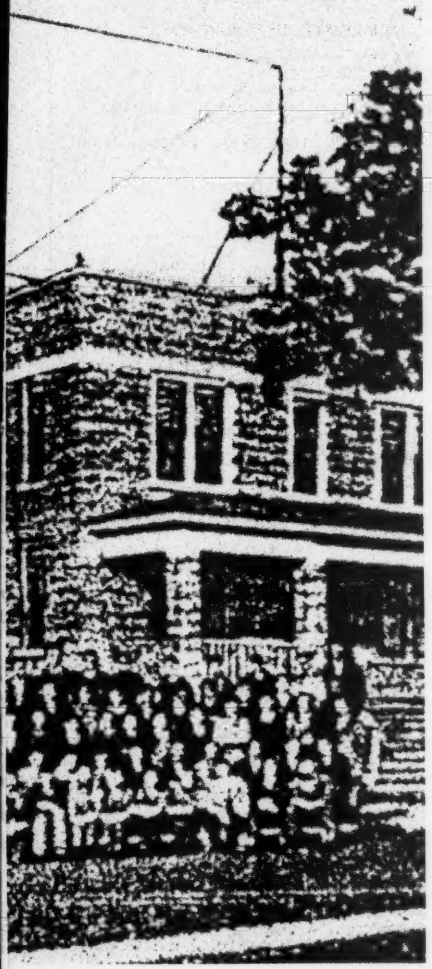

Photo B. Annual meeting of the Southern California chapter of the Morse Telegraph Club. The author is seated. Samuel F.B. Morse stands behind the author on his right.

ing. In short, neither I nor my co-workers at the Western Union office in Fargo ever needed to break.

Unless, of course, we were copying from the *World Champion of Rotten Morse*, a railroad agent in eastern North Dakota nicknamed Frenchy. In one master stroke of genius he simplified the American Morse code. Frenchy considered two dots to be a very nice code character—so he used two dots to represent all of the following letters: A, C, I, O, S, U and sometimes W. This made perfect sense to Frenchy but not much to those operators who had to copy his unique style of telegraphy. I once heard the late John Atkinson, wire chief for the Great Northern Railway at Minot, North Dakota, use the railroad telephone to call Frenchy after a frustrating twenty minutes of deciphering his code. "Damn you, Frenchy, you have sent me your message five times now and every time you send it you send it differently. Now give it to me here on the phone and stay off the telegraph wires."

The nickname Frenchy for poor practioners of telegraphy took hold. In the extreme western section of North Dakota another Frenchy emerged who was also a railroad agent. He matched the eastern Frenchy's ineptitude with American Morse telegraphy.

The immediate supervisor of the western Frenchy was a train dispatcher located in Enderlin, North Dakota. He was a high-strung individual who became extremely excited and nervous when placed under stress. For anyone in the profession of dispatching trains, this is a poor personality trait. He kept a box of baking soda right on his desk, together with a glass of water and a teaspoon in order to combat the large quantities of hydrochloric acid, which his vagus nerve constantly generated. The western end of the Soo Line Railroad, which he supervised, had no telephone lines. Therefore, his only means of communicating with Frenchy was over the number 8 iron telegraph wire extending from Enderlin to Frenchy's depot. Another dispatcher in charge of Soo Line trains east of Enderlin sat directly across a so-called double desk from the nervous one.

On one occasion, the western dispatcher desperately needed Frenchy's services, since two trains were to meet at his station. Unfortunately, instead of being on duty at the depot, Frenchy was at the local beer tavern attempting to add the title of local pool champion to his notariety as the co-champion world's worst telegrapher.

Meanwhile, back at the nerve center of the railroad in Enderlin, the systolic blood pressure of the western dispatcher increased alarmingly, and his consumption of baking soda reached an all-time high. The dispatcher seated across the desk became concerned. As the pool championship wore on, the nervous dispatcher had plenty of time to compose in his mind just what he would say to dress down Frenchy in Morse code.

The AWOL telegrapher finally did return to his depot, and the dispatcher telegraphed a two-minute lecture to Frenchy—expectedly vitriolic and uncomplimentary.

Frenchy made a perfect reply—a question mark. In American Morse code, the question mark conveys the meaning of "I don't understand" what the sending operator has just transmitted. When Frenchy sent the question mark, the eastern dispatcher said later that he was positive that his nervous co-worker nearly suffered a stroke.

(Part 2 of *Memoirs of a Former Telegrapher* will follow next month.)

Dr. William C. Hess, W6CK, lives in Pasadena CA (PO Box 19/M). He presided over the North Dakota depot of Woburn, a tiny village in North Dakota, from 1937 through 1942.

Fig. 1. Morse telegraph codes: United States and continental versions.

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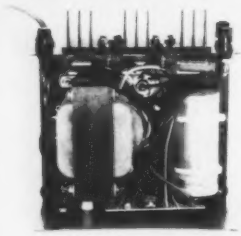

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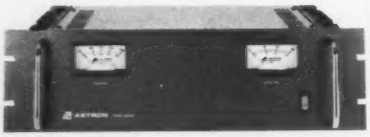

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RM-50M	37	50	5¼ × 19 × 12½	50

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RS-5A	4	5	3½ × 6⅛ × 7¼	7
RS-7A	5	7	3¾ × 6½ × 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 × 7½ × 10¾	11
RS-12A	9	12	4½ × 8 × 9	13
RS-12B	9	12	4 × 7½ × 10¾	13
RS-20A	16	20	5 × 9 × 10½	18
RS-35A	25	35	5 × 11 × 11	27
RS-50A	37	50	6 × 13¾ × 11	46

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VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
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RS-10S	7.5	10	4 × 7½ × 10¾	12
RS-12S	9	12	4½ × 8 × 9	13
RS-20S	16	20	5 × 9 × 10½	18

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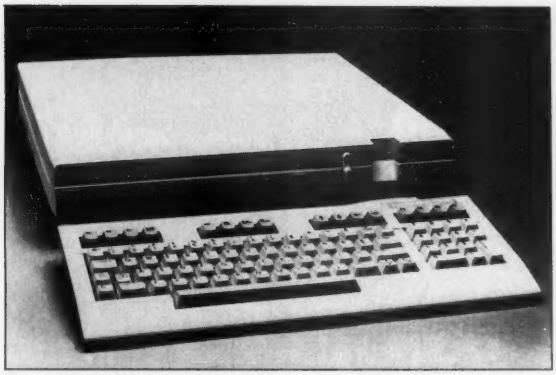

Commodore's 128D Integral Personal Computer.

COMMODORE

There's something new at Commodore—the **Commodore 128D Integral Personal Computer.** Built-in 1571-compatible Fast Disk Drive with 128K RAM for advanced applications, saves time and increases productivity. It has a 92-key, detachable keyboard with flexible cord for easy input. The user can select 40/80 column full-color output or 512K for rapid data access with RAM expansion module.

The Commodore 128D runs off-the-shelf CP/M® software such as WordStar,® dBase II,® and The Perfect Series®. It is also compatible with the Commodore 64 software and peripherals. The 128D has a suggested list price of $600.

And if you would like more information about the Commodore 128D either contact your local Commodore Dealer or write to Commodore Business Machines, 1200 Wilson Dr., Westchester PA 19380 (215/431-9100). Or circle Reader Service Card #202.

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Antennas West announces the introduction of its **QRV-SOLAR 23 Solar Power Supply** designed specifically to provide mains-independent power for remote repeaters, portable or RV-based stations, and home amateur radio installations. The heart of the system is an easily-installed unbreakable and bullet-tested solar panel with unique linear current boosting circuitry. The QRV-SOLAR 23, rated at 23 Watts, delivers 1.65 Amperes at 14 Volts and increased current at lower voltages. In a typical repeater installation, a single QRV-SOLAR 23 will support normal 24-hour usage while maintaining a full charge on the battery.

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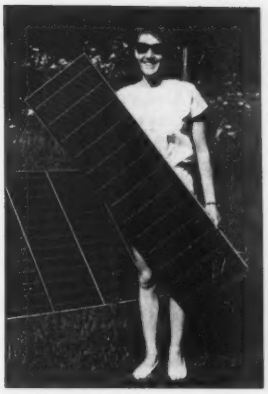
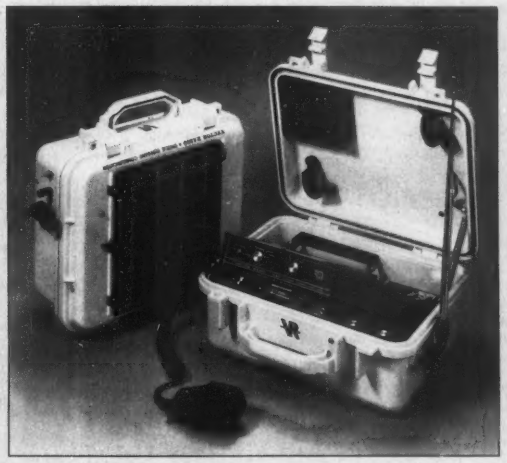
The QRV-SOLAR 23 is available for immediate delivery from Antennas West at $200 postpaid. An optional kit for mounting on vertical masts is available at $30.

For more information contact Antennas West, 1971 N. Oak Lane 1300 E., Provo UT 84604-2138 (801/374-1084). Or circle Reader Service Card #204.



Antennas West announces the QRV-Solar 23 Solar Power Supply.



VECTOR RADIO

Yachtsmen who are hams, long-distance sailors, cruisers, ocean racers, commercial fishermen, and boatmen who want guaranteed survival communications in the event of emergencies have been waiting decades for the appearance of something like the new **Vector Radio VR-50 Transceiver.**

The VR-50 is powered by a rechargeable battery which is maintained at full charge by a photovoltaic solar panel on top of its waterproof floating case. The high-visibility impact-proof case is made of tough plastic with scuba-type "O" rings. It takes up a mere ½ cubic foot and measures only 14" x 11" x 6" with a weight of only 16 pounds. The 8-foot telescoping whip antenna stores inside the case when not in use. An internal antenna-tuner which matches the antenna is built into the set. The VR-50 may be used with a wide range of auxiliary antennas.

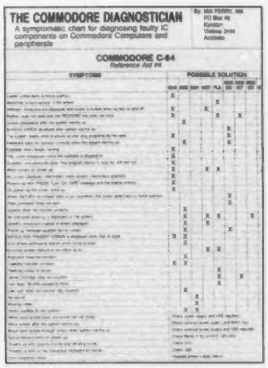
The remarkable new "around-the-world" radio puts out 50 Watts PEP (peak envelope power) on voice and 25 Watts on CW (code). The set is crystal controlled for "on the money" tuning of a total of 24 channels in the 1.8 to 17 Megahertz short, medium, and long distance bands.

The VR-50 sells for $1,300 and is manufactured by *Vector Radio Company, 3207 Roymar Rd., Oceanside CA 92054; (619/722-4099). Or circle Reader Service Card #203.*

KASARA MICROSYSTEMS

Newly released from Kasara Microsystems is the **Commodore Diagnostician.** It allows the average Commodore computer user to diagnose and fix their machine when it's broken 95% of the time. The Diagnostician is inexpensive and would certainly be of value to the ham operator. It sells for $7 plus $1 shipping and handling. (Other Diagnosticians to be released soon: IBM Diagnostician, 1 and 2.)

For further information contact Kasara Microsystems, 33 Murray Hill Drive, Spring Valley NY 10977


THE COMMODORE DIAGNOSTICIAN

A symptomatic chart for diagnosing faulty IC components on Commodore Computers and peripherals

COMMODORE C-64

Reference Aid #4

SYMPTOMS | POSSIBLE SOLUTION

Commodore Diagnostic Chart from Kasara.

(914/356-3131) or circle Reader Service Card #208.

ANTENNA SPECIALISTS

A new 4-page bulletin, #RFA-4001, describing the company's newly-designed line of RF power amplifiers is available from the Antenna Specialists Co. Complete performance specifications and typical output-vs.-input power graphs on each of ten models are presented. The line comprises three VHF models covering 144-174 MHz; four models covering 432-512 MHz UHF band; and three additional export models operating in the midband frequency range. State-of-the-art micro-strip matching and filtering, relay T/R switch for minimal insertion loss, and full protection against DC polarity reversal and high VSWR are characteristic of the complete line. To receive a copy of the FREE bulletin, contact: The Antenna Specialists Company, 30500 Bruce Industrial Parkway, Cleveland OH 44139-3996. Or circle Reader Service Card #210.

MINK IMPORT-EXPORT

The German-made **ERSA MS 6000 electronic soldering station**, long popular in Europe, is now available in the United States. The ample power supply (60VA) and the TE 40 iron with a novel position temperature coefficient (PTC) heating element permit a large field of applications. They range from the most delicate operations to operations for which uncontrolled irons of up to 100 W have been used. The high-energy reserve of the PTC heating element and the transformer provide a virtually constant soldering temperture even in rapid soldering sequences. The unit features a 60-second heat-up time.

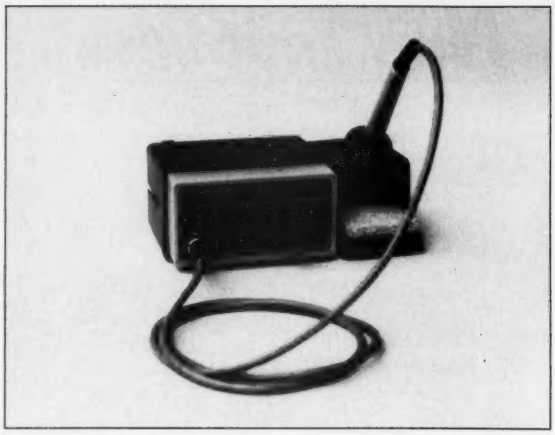
The safety-insulated electronic control unit includes a 110/24V transformer and is continuously variable for tip temperatures between 300 and 840 degrees Fahrenheit. The heater-windings of the soldering iron also serve as a temperature setting. By means of zero voltage circuits and a Triac, the heating element is supplied with energy and the operating state is indicated by a red light-emitting diode. The soldering tip is connected with the level potential terminal through a high Ohm resistor. The price class for the ERSA 3000 is $120. Five tips are available for $4.

For additional information contact Robert W. Mink Import-Export Inc., PO Box 6437, Fair Haven NJ 07704 (201/758-8838) or circle Reader Service Card #214.

Antenna Specialist RF Amplifiers.

DAVLE TECH

The **Model A-TEK IC test clip** is designed to facilitate temporary connections to the dual-in line packaged components in conjunction with a number of test instruments for power on/hands off circuit testing. There are many types of test clips available: a 16 pin, 20 pin, 24 pin and 40 pin. Standard DIP spacing, gold plated contacts, low contact resistance, less than 1 mili-Ohm at 1 KHz.



Mink Soldering Station, ERSA MS 6000.

For more information contact Davle Tech Inc. 2-05 Banta Place, Fair Lawn NJ 07410 (201/796-1720) or circle Reader Service #215.

ELECTRON PROCESSING

Electron Processing announced the addition of two new models in their product line of Signal Intensifier ™ RF amplifiers.

New series **RFC Signal Intensifiers** are 12 volt dc powered versions of their popular RFA series. These low-cost yet high performance receiver preamplifiers are ruggedly made for lasting performance in the grueling environment of today's automobiles.

Available in two versions, the RFC-30 covers 500 KHz to 150 MHz and the RFC-16 covering 50 MHz to 1000 MHz. Both amplifiers provide 13 dB gain and are supplied with convenient Motorola connectors. Power required is approximately 25 mA at 10 to 18 volts dc, negative ground. Pricing starts at $30 Amateur Net with quantity discounts available.

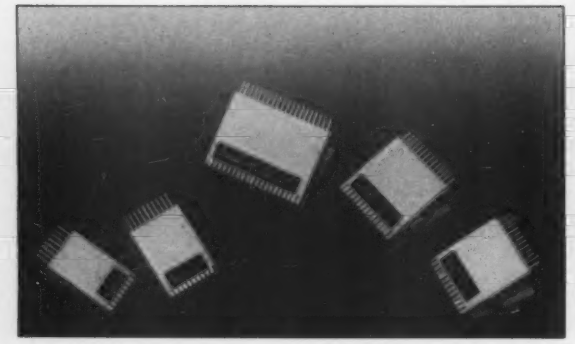
For more details and ordering information, contact the Sales Department, Electron Processing, Inc., P.O. Box 708, Medford NY 11763 (516/764-9798). Or circle Reader Service Card #205.

ADVANCED RADIO DEVICES

Two years in development the 230A represents a new dimension in **linear amplifier** technology and operating convenience. The 230A provides maximum legal power on all amateur bands with no time limit. The drive frequency is continuously monitored by the processor and adjustments made to ensure maximum amplifier output at all times.

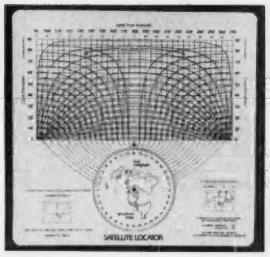
Introductory price for the 230A is $3,650 (Made in the USA).

For more information contact Advance Radio Devices, 103 Carpenter Drive, Sterling VA 22170 (703/478-3100) or circle Reader Service Card #211.



Davle Tech's A-TEK IC Test Clip.

Electron Processing's RFC Signal Intensifier.



The Satellite Locator, a WTS product.

THE SATELLITE LOCATOR

The Satellite Locator is a slide rule that gives azimuth/elevation angles to geosynchronous satellites from almost anywhere on earth. On the slide rule there are visual representations of the full satellite arc—horizon-to-horizon, around the world, even from the southern hemisphere—with local azimuth and elevation angles. It also gives the U.S. satellite longitude positions, a magnetic declination map of the U.S., a true-to-magnetic azimuth conversion slide rule and handy az-el formulas.

This device allows the quick determination of az-el angles from anywhere on earth that the satellite arc is visible. A magnetic declination map and a true/magnetic slide rule on the back allows the true azimuth to be converted to local magnetic azimuth. The az-el formulas are also printed on the back to allow more precise angle computation with a portable calculator.

The price for the Satellite Locator is $10. Shipping is included and quantity rates are available.

For more information, please contact WTS Products, 4308 South Peoria Suite 681, Tulsa OK 74105, or circle Reader Service Card #206.

SUPERTEMP XY7

The SUPERTEMP XY7 soldering stations offer controlled temperature hand soldering. Fixed temperatures are selectable by rotating the switch. A unique electronic control circuit maintains tip temperature to within ± 3°C (6°F). This is accomplished by embedding the thermocouple sensing unit in the bevel of the heating element barrel so that the tip actually seats against it. This method allows the closest possible monitoring of tip working surface temperature.

The specially insulated NICHROME wire heating element is compressed between two layers of stainless steel for ruggedness and is located at the end of the barrel to insure instant heat up and recovery. The revolutionary electronic "Zero Voltage" switching protects voltage and current-sensitive devices such as CMOS against transient voltage spikes caused in stations. The soldering tip is grounded through the power unit to insure the tip leakage is less than 0.4 millivolt or 0.03 microampere.

Supertemp XY7 from Davle.

Additional information is available from Davle Tech Inc., 2-05 Banta Place, Fair Lawn NJ 07410 (201/796-1720) or circle Reader Service Card #213.

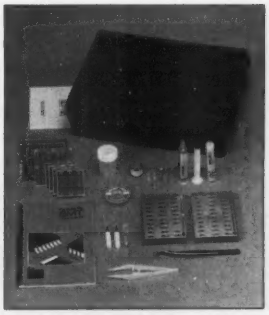
NEW VECTOR SMT TRAINING KIT

Jensen Tools has designed a kit to give electronic engineers and technicians a working knowledge of materials and methods to use with Surface Mount (SMT) semiconductor assembly technology.

The kit contains SMT devices, prototyping boards, component attachment and interconnection materials and a comprehensive 50-page instruction manual. Included are 270 capacitors, 300 resistors, 10 diodes, 10 transistors, 5 different ready-to-use double-sided circuit boards with layout/planning sheets, a single-sided board with six PLCC patterns, two-part conductive adhesive that cures at room temperature, solder paste with dispenser needles, solder wire, solder removal braid, 1 plastic and 1 stainless steel tweezers, and pins for piggyback mounting of finished PC boards on larger circuit boards.

The illustrated "Guide to SMT" manual contains detailed instructions on attaching and removing SMT devices.

For more information write or call Jensen Tools, 7815 S. 46th Street, Phoenix AZ 85044 (602/968-6231) or circle Reader Service Card #208.



Vector SMT Training Kit by Jensen Tool.

WIDEBAND ENG BANDPASS FILTER

Microwave Filter Company, Inc., has come out with a new wideband ENG bandpass filter. Model 5348 bandpass filter has a flat passband of 26 MHz in the remote pick-up ENG band (1990-2110 MHz). It has high selectivity to isolate several contiguous channels.

The 5348 has an insertion loss less than 1.5 dB with a 3 dB roll-up bandwidth greater than 26 MHz. The center frequency is a customer option. Selectivity is 30 dB minimum at ± 23 MHz. Impedance is 50 Ohms and connectors are type N. The base plate is 1.5 x 9 inches and has mounting provisions.

Price is $445 and delivery is 30 days.

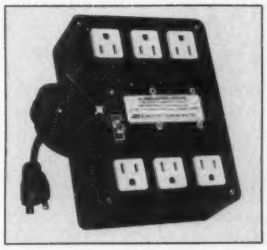
For more information contact Microwave Filter Company, Inc., 6743 Kinne Street, East Syracuse NY 13057 (800/448-1666) or circle Reader Service Card #209.

POWER FAIL INTERRUPT

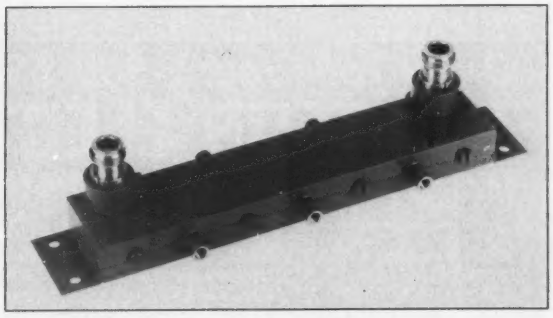
Electronic Specialists has expanded their equipment protection line to include filter/suppressors and 20/30 Amp protective devices.

The power fail interrupt can now be ordered as an adjunct to all Electronic Specialists' power conditioning equipment. Option price is $95 installed.

For more information write to Electronic Specialists, Inc., 171 South Main Street, Natick MA 01760 (800/225-4876) or circle Reader Service Card #203.



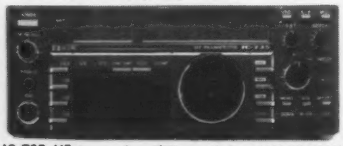
Power/fail/interrupt by Electronic Specialists.



Wideband ENG Bandpass Filter from Microwave.

HF Equipment	Regular	SALE
IC-761 HF xcvr/SW rcvr/ps/AT	2499.00	2149
HM-36 Scanning hand microphone	47.00	
SP-20 Ext. speaker w/audio filter	149.00	139.95
FL-101 250 Hz 1st IF CW filter	73.50	
FL-53A 250 Hz 2nd IF CW filter	115.00	109.95
FL-102 6 kHz AM filter	59.00	
EX-310 Voice synthesizer	59.00	

IC-751A 9-band xcvr/.1-30 MHz rcvr	1699.00	1449
PS-35 Internal power supply	219.00	199.95
FL-32A 500 Hz CW filter (1st IF)	69.00	
FL-63A 250 Hz CW filter (1st IF)	59.00	
FL-52A 500 Hz CW filter (2nd IF)	115.00	109.95
FL-53A 250 Hz CW filter (2nd IF)	115.00	109.95
FL-33 AM filter	49.00	
FL-70 2.8 kHz wide SSB filter	59.00	
RC-10 External frequency controller	49.00	



IC-735 HF transceiver/SW rcvr/mic	999.00	869.95
PS-55 External power supply	219.00	199.95
AT-150 Automatic antenna tuner	445.00	389.95
FL-32A 500 Hz CW filter	69.00	
EX-243 Electronic keyer unit	64.50	
UT-30 Tone encoder	18.50	

Other Accessories	Regular	SALE
IC-2KL 160-15m solid state amp w/ps	1999.00	1699
PS-15 20A external power supply	175.00	159.95
PS-30 Systems p/s w/cord, 6-pin plug	319.00	289.95
MB Mobile mount, 735/751A/761A	25.99	
SP-3 External speaker	65.00	
SP-7 Small external speaker	49.00	
CR-64 High stab. ref. xtal for 751A	79.00	
PP-1 Speaker/patch	179.00	164.95
SM-6 Desk microphone	47.95	
SM-8 Desk mic - two cables, Scan	89.00	
SM-10 Compressor/graph EQ, 8 pin mic	149.00	139.95
AT-100 100W 8-band auto. antenna tuner	445.00	389.95
AT-500 500W 9-band auto. antenna tuner	589.00	519.95
AH-2 8-band tuner w/mount & whip	659.00	589.95
AH-2A Antenna tuner system, only	519.00	449.95
GC-5 World clock	91.95	89.95

VHF/UHF base multi-modes	Regular	SALE
IC-275A 25W 2m FM/SSB/CW w/ps	1235.00	1079
IC-275H 100W 2m FM/SSB/CW	1389.00	1229
IC-375A 25W 220 FM/SSB/CW	1399.00	1249
IC-475A 25W 440 FM/SSB/CW w/ps	1399.00	1249

ICOM

IC-475H 75W 440 FM/SSB/CW	1599.00	1429
IC-575A 25W 6/10m xcvr w/ps	1399.00	1249

IC-471A* 25W 430-450 CLOSEOUT	979.00	749.95
PS-25 Internal power supply	125.00	114.95
AG-1* Mast mounted preamplifier	99.50	
IC-471H* 75W 430-450 CLOSEOUT	1399.00	989.95
PS-35 Internal power supply	219.00	199.95
AG-35* Mast mounted preamplifier	99.75	

***Preamp $9.95 with 471A or 471H Purchase**

Accessories common to 271A/H and 471A/H	
SM-6 Desk microphone	47.95
EX-310 Voice synthesizer	59.00
TS-32 CommSpec encode/decoder	59.95
UT-15 Encoder/decoder interface	33.95
UT-15S UT-15S w/TS-32 installed	96.00

VHF/UHF mobile multi-modes	Regular	SALE
IC-290H 25W 2m SSB/FM CLOSEOUT	639.00	549.95
IC-490A 10W 430-440 CLOSEOUT	699.00	399.95

VHF/UHF/1.2 GHz FM	Regular	SALE
IC-27A Compact 25W 2m FM w/TTP mic	429.00	379.95
IC-27H Compact 45W 2m FM w/TTP mic	459.00	399.95
IC-37A Compact 25W 220 FM, TTP mic	499.00	439.95
IC-47A Compact 25W 440 FM, TTP mic	549.00	489.95
PS-45 Compact 8A power supply	145.00	134.95
UT-16/EX-388 Voice synthesizer	34.99	
SP-10 Slim-line external speaker	35.99	
IC-28A 25W 2m FM, TTP mic	469.00	409.95
IC-28H 45W 2m FM, TTP mic	499.00	439.95
IC-38A 25W 220 FM, TTP mic	489.00	429.95
IC-48A 25W 440-450 FM, TTP mic	509.00	449.95
HM-14 Extra TTP microphone	59.00	
UT-28 Digital code squelch	39.50	
UT-29 Tone squelch decoder	46.00	
HM-16 Speaker/microphone	34.00	
IC-900A Transceiver controller	589.00	529.95
UX-29A 2m 25W unit	295.00	269.95
UX-29H 2m 45W unit	339.00	309.95
UX-39A 220MHz 25W unit	349.00	319.95
UX-49A 440MHz 25W unit	339.00	309.95
UX-59A 6m 10W unit	339.00	309.95
IC-3200A 25W 2m/440 FM w/TTP	649.00	579.95
UT-23 Voice synthesizer	34.99	
AH-32 2m/440 Dual Band antenna	39.00	
AHB-32 Trunk-lip mount	35.00	
Larsen PO-K Roof mount	20.00	
Larsen PO-TLM Trunk-lip mount	22.00	
Larsen PO-MM Magnetic mount	22.00	
IC-1200A 10W 1.2GHz FM Mobile	699.00	629.95
IC-1271A 10W 1.2GHz SSB/CW Base	1269.00	1129
AG-1200 Mast mounted preamplifier	105.00	
PS-25 Internal power supply	125.00	114.95
EX-310 Voice synthesizer	59.00	
TV-1200 ATV interface unit	139.00	129.95
UT-15S CTCSS encoder/decoder	96.00	
RP-1210 1.2GHz 10W 99 ch FM xcvr	1529.00	1349
RP-2210 220MHz 25W repeater	1499.00	1329
RP-3010 440MHz 10W FM repeater	1299.00	1149

MasterCard VISA

Hand-helds	Regular	SALE
IC-2A 2-meters	289.00	259.95
IC-2AT with TTP	319.00	279.95
IC-3AT 220 MHz, TTP	349.00	299.95
IC-4AT 440 MHz, TTP	349.00	299.95
IC-02AT/High Power	409.00	349.95
IC-03AT for 220 MHz	449.00	389.95
IC-04AT for 440 MHz	449.00	389.95
IC-u2AT with TTP	329.00	289.95
IC-u4AT 440 MHz, TTP	369.00	329.95

Accessories for micros - CALL $

IC-12AT 1W 1.2GHz FM HT/batt/cgr/TTP	473.00	419.95
A-2 5W PEP synth. aircraft HT	499.00	449.95
A-20 Synth. aircraft HT w/VOR	599.00	529.95

Accessories for all except micros	Regular
BP-7 425mah/13.2V Nicad Pak - use BC-35	79.00
BP-8 800mah/8.4V Nicad Pak - use BC-35	79.00
BC-35 Drop in desk charger for all batteries	79.00
BC-16U Wall charger for BP7/BP8	21.25
LC-11 Vinyl case for DIx using BP-3	20.50
LC-14 Vinyl case for DIx using BP-7/8	20.50
LC-02AT Leather case for DIx models w/BP-7/8	54.50

Accessories for IC and IC-O series	Regular
BP-2 425mah/7.2V Nicad Pak - use BC35	49.00
BP-3 Extra Std. 250 mah/8.4V Nicad Pak	39.50
BP-4 Alkaline battery case	16.00
BP-5 425mah/10.8V Nicad Pak - use BC35	65.00
CA-5 5/8-wave telescoping 2m antenna	19.95
FA-2 Extra 2m flexible antenna	12.00
CP-1 Cig. lighter plug/cord for BP3 or DIx	13.50
CP-10 Battery separation cable w/clip	22.50
DC-1 DC operation pak for standard models	24.50
MB-16D Mobile mtg. bkt for all HTs	25.99
LC-2AT Leather case for standard models	54.50
RB-1 Vinyl waterproof radio bag	34.95
HH-SS Handheld shoulder strap	16.95
HM-9 Speaker microphone	47.00
HS-10 Boom microphone/headset	24.50
HS-10SA Vox unit for HS-10 & Deluxe only	24.50
HS-10SB PTT unit for HS-10	24.50
ML-1 2m 2.3w in/10w out amplifier	SALE 99.95
SS-32M Commspec 32-tone encoder	29.95

Receivers	Regular	SALE
R-71A 100kHz to 30MHz receiver	$979.00	849.95
RC-11 Infrared remote controller	70.99	
FL-32A 500 Hz CW filter	69.00	
FL-63A 250 Hz CW filter (1st IF)	59.00	
FL-44A SSB filter (2nd IF)	178.00	159.95
EX-257 FM unit	49.00	
EX-310 Voice synthesizer	59.00	
CR-64 High stability oscillator xtal	79.00	
SP-3 External speaker	65.00	
CK-70 (EX-299) 12V DC option	12.99	
MB-12 Mobile mount	25.99	
R-7000 25MHz to 2GHz scan rcvr	1139.00	999.95
RC-12 Infrared remote controller	70.99	
EX-310 Voice synthesizer	59.00	
TV-R7000 ATV unit	139.00	129.95
AH-7000 Radiating antenna	99.00	(8)

HOURS • Mon. thru Fri. 9-5:30; Sat. 9-3

Milwaukee **WATS** line: **1-800-558-0411** answered evenings until 8:00 pm Monday thru Thursday. **WATS lines are for Quotes & Ordering only, use Regular line for other Info & Service dept.**

All Prices in this list are subject to change without notice.

Order Toll Free: 1-800-558-0411

In Wisconsin (outside Milwaukee Metro Area) 1-800-242-5195

AMATEUR ELECTRONIC SUPPLY® Inc.

4828 W. Fond du Lac Avenue; Milwaukee, WI 53216 • Phone (414) 442-4200

AES® BRANCH STORES — Associate Store

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Phone (216) 585-7388
Ohio WATS 1-800-362-0290
Outside Ohio 1-800-321-3594

ORLANDO, Fla. 32803
621 Commonwealth Ave.
Phone (305) 894-3238
Fla. WATS 1-800-432-9424
Outside Florida 1-800-327-1917

CLEARWATER, Fla. 34625
1898 Drew Street
Phone (813) 461-4267
No In-State WATS
No Nationwide WATS

LAS VEGAS, Nev. 89106
1072 N. Rancho Drive
Phone (702) 647-3114
No In-State WATS
Outside Nevada 1-800-634-6227

CHICAGO, Illinois 60630
ERICKSON COMMUNICATIONS
5456 N. Milwaukee Avenue
Phone (312) 631-5181
15 min. from O'Hare!

Never Say Die

Continued from p. 6

able for readers is for them to provide more interaction between readers. When it comes to a review of a piece of new ham gear I'd rather know what ten fairly average hams who've bought it think of it than to read one engineer's opinion.

Now that about 70% of you have computers you should at least be able to write letters to *73* without having to tear pages from a spiral notebook and scribble with a blunt pencil. So let's get started coping with the Information Age. What ham gear have you bought recently? How has it been to use? Have you had any problems with it? Has the manufacturer or importer been cooperative? How about your ham dealer? How easy was it to get fired up? What features do you like about it? What don't you like? Do you recommend that others get one too? What can you tell them to help them get better use from it? Have you any suggestions to the manufacturer on ways to improve future models? What features would you like to see? How about the price?

I'm not going to feel comfortable that *73* is doing what it should until we've published at least two or three reader reviews of every piece of ham gear I'm likely to find advertised in the magazine.

So let's see what you think of any new gear you've bought. Fire up your word processor, put in the dictionary disk and have at it. Send me the print-out and a floppy, either 3″ or 5″ so I won't have to make someone sit and retype your review.

One practical matter you should keep in mind...the thickness of *73* depends entirely on how many pages of advertising we have, so let's not go out of our way to be nasty. No, I'm not saying you should lie or distort your facts—just don't get carried away with negatives.

Most of the letters I get are wonderful, but every now and then I get a nasty one. Yes, I realize that I'm probably not being singled out for the nasty attack—that this poor chap is inflicting the same lousy treatment on his wife, family and business associates. So I sigh sadly when I get rotten letters and try not to get mad in return.

We're getting more advertising in *73*—with some very satisfying success stories from several advertisers. The more pages of ads we have, the more magazine you'll get every month. The percentage of ads should run about 50% these days. It used to run about 30%, but when one of the ham magazines went to 50% and thus cut their advertising rates accordingly, the other ham magazines had to follow suit.

Sure, you can help make *73* fatter. Sending in the Reader's Service card asking for information about advertised products helps. Mentioning *73* when you write advertisers helps. Buying the products advertised in *73* is the biggest boost of all.

Problems with Products?

By the way, if you ever run into any problems with the products or services of a *73* advertiser, please be sure to let me know about it. I'm by far the most picky of the ham publishers when it comes to accepting advertising. What you do is this: write a detailed letter giving the facts of your complaint—just the facts, without all the invective is the best approach—send the letter to the firm with a note on the bottom that a copy is going to Wayne Green. This usually does wonders at getting their attention. You can be sure that my staff will be asking questions of this firm. Please don't embarrass me by exaggerating or distorting the facts, okay?

"The chap who builds just hates to write, so maybe you can collaborate with him"

This system has worked wonders down through the years. I've helped get some dishonest ham advertisers convicted and jailed—and I've steered readers away from many ripoffs. But I need to get early warnings from you.

You know, if we can get a few more advertisers back into *73* we can put out those big fat issues we used to a few years ago. So how about helping the manufacturers out? If you get a piece of gear you think everyone ought to know about, write it up. If you find a ham dealer who goes out of his way to help you, help him back with a writeup I can publish in *73*. This is the Information Age! Or at least it will be if you'll stop sitting on information and break loose. Wouldn't you like to see your name and call in print? What a feeling that is! You'll be absolutely astounded at how many of your friends will spot it and how often chaps will mention seeing your piece when you work them.

What else? Well, the *73* readers seem to agree just about 100%—they want to see short construction projects in the magazine. If you've got someone in your area or in your club who likes to build gadgets, see what you can do to get them to write 'em up for us. Or, as is so often the case, the chap who builds just hates to write, so maybe you can collaborate with him and get both your names in print. There are some hams who love to write and are remarkable in their ability to find non-writing ham builders to promote.

I sure wish there was someone who could translate some of the Japanese ham magazine construction projects into English. They have more stuff in their ham magazines every month than I'm able to get here in a year. There's nothing like having about five times as many hams—and most of them youngsters—to develop an interest in building. Of course they have an enormous advantage over us in getting parts. They can shop at the hundreds of small parts shops in the Akihabara section of Tokyo. If you visit there you'll see thousands of kids eagerly buying parts, chips and circuit boards.

Indeed, few parts are made in America any more, so we're almost entirely dependent on imported parts. When our consumer electronic industries all moved their manufacturing to Japan, so did the parts companies that supplied them. Even the companies making the machines to make the parts are out of business now, so we've a long row to hoe before we can rebuild America's electronic industries. Oh well, you've read all that many times before—it rankles me, so I won't let go. So let's get started coping with the Information Age. Let me know how we can improve the index. Start writing your impressions of new ham gear. You might even write if you have any experiences or ideas which others might find of value—like how to get ham clubs started or rebuilt—how to get school radio clubs going—how to attract youngsters to our great hobby.

73 is a communications medium, so start communicating.

The Hamvention

The word is that I'll be speaking again on Saturday afternoon at Dayton. Bring something to eat and a cushion—they've allocated three hours! But that brings up the question—what would you like me to talk about? I've been giving the same talk for the last two years about how amateur radio needs growth. I don't want to play the same old record every year.

Would you be interested in my going into some of the new communications technologies amateurs should be pioneering? Is anyone interested in a historical perspective of our hobby? I've been a ham for almost 50 years now, and I've been a ham editor/publisher for 37 of those years, so you aren't going to find anyone with a broader perspective.

Or is there some interest in how to use your amateur radio interest to make money—either as a side line or even as a business? I'm a big fan of taking advantage of technology to start small firms and get rich. Indeed, I've helped thousands of small firms grow into million dollar size over the years.

I'll talk about anything you want, so please drop me a line with your ideas. If you're interested in DXing I might talk about some of the more interesting countries I've visited. You know, it really isn't all that expensive to travel as a ham, so perhaps you're missing some fun.

You want me to talk about UHF and my working seven states on 10 GHz? As far as I know, no one has come close to my record yet.

Or perhaps you'd like to have some ideas on ways to make your ham club grow and be more fun—ways to attract potential Novices—ways to help Novices get on the air at low cost and still have a ball. How about cross-banding repeaters to make it possible for Novices to work some 20m DX?

Please advise. 73

73 Book Review

Essential References for the Builder

Two circuit collections from Harry Helms

reviewed by Larry Antonuk WB9RRT

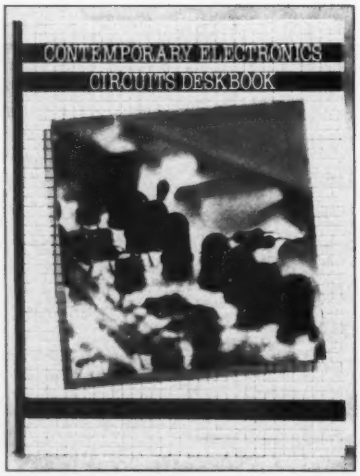
Contemporary Electronics Circuits Deskbook
McGraw-Hill Book Company 1986
Hardbound, 253 Pages (Illustrated)

Existing circuit anthologies suffer from two major drawbacks. First, they are filled with less-than-useful circuits: It may be fun to know how a rain detector works, but I'll just keep looking out the window. Second, once you find a circuit that fits your needs, you discover that it was pulled from a ten-year-old magazine. All the part numbers produce nothing but blank stares down at Radio Shack. You decide to build the gadget anyway, substituting a chip and a transistor or two. It doesn't work. Was it a wiring error? The substitutions weren't valid? Or maybe the circuit wasn't correct in the first place?

The *Contemporary Electronics Circuits Deskbook* overcomes both of these problems quite nicely, at least as far as the ham radio operator is concerned. Drawing mainly on past issues of *QST*, *73 Magazine*, and *Ham Radio*, the *Deskbook* is filled with circuits that are ham radio oriented, or would at least interest hams. To round things out, the book includes sections on audio, automotive, video, timers, and, of course, popular miscellaneous circuits. In addition, most of the circuits are from 1983 or later, which ensures that the chips and transistors have friendly, familiar numbers on them.

The table of contents lists 28 categories, which cover practically every aspect of electronics. Some of the sections are rather slim, notably Automotive and Optoelectronics. Most of the categories, however, are quite comprehensive—containing fifteen to twenty separate circuits. The most-used chapters will probably be Interfacing (just how do I drive TTL with CMOS??) and Power Supplies (how to hook up all those regulator chips).

Rather complex circuits take up a fair amount of space in the book, which is not necessary. No home hobbyist will whip up a fourteen-IC Digital Multimeter on the basis of one schematic found in a circuit collection. He wants theory of operation, PC board layouts, pictorials, parts sources, etc. This isn't a major problem, though, since the source of the circuit is listed with each diagram. If a particular circuit seems especially interesting, that back issue of *73 Magazine* (or whatever) can be pulled out for a complete description.



Weighing in at $30 for the hardcover edition, the *Contemporary Electronics Circuits Deskbook* is somewhat of a heavyweight. For those folks with the last seventeen years of *73*, *QST*, and *Ham Radio* in their garage, the book may not be much of a bargain. But with those of us who keep our electronics library stored in a milk crate, the *Deskbook* is a good investment both as a reference book and for casual browsing.

Handbook of Practical IC Circuits
Prentice-Hall 1987
Hardbound, 160 pages (Illustrated)

Handbook of Practical IC Circuits is a tribute to the integrated circuit whose arrival undoubtedly constitutes the single most significant event in the history of hobbyist electronics. This phenomenon has changed the whole approach to home building. Need a time? No need to lash together a handful of transistors—just tie a cap and a few resistors to a 555 and you're in business. The time usually spent on debugging can be put toward further testing or experimentation. (As a comparison of time saved by using ICs, think of building the equivalent of a 741 op-amp with tubes!) For the most part, hobby electronics now consists of hooking up various "building blocks" to get the desired result.

So where does one go to get the information needed to work with ICs? Obviously, all the manufacturers publish data sheets and application notes, but these are often too complex, and the circuits too sketchy. Circuit "cookbooks" are fine, as long as they have just what you want listed. If you need a slightly different circuit, or if things don't work when you plug them in, you're in trouble. The *Handbook of Practical IC Circuits* gives the builder a comfortable blend of circuit explanation and already-debugged circuits. Should the reader need a variation of one of the circuits listed, the accompanying text gives enough explanation so the changes can be successfully made.

The handbook can be used as a reference guide when designing a specific type of circuit, or it can be read as a tutorial. The circuits all use commonly available parts—a handful of ICs, a prototype board, and a power supply will turn the book into a beginner's course on basic IC technology. Helms has written the book in a light, readable style that makes reading about shift registers interesting (almost).

The *Handbook of Practical IC Circuits* is wrapped up with a short interfacing and troubleshooting section. The troubleshooting section contains this gem: "Blame Yourself First and the IC Last." (Repeat this five times if something you've built doesn't work.) The integrated circuit, in addition to being extremely easy to use, is very reliable. Between the reliability of the ICs and the solid information contained in this handbook, it shouldn't be necessary to blame anyone—your circuits should all work the first time around!

The Next Phase in Packet Radio
Is Just Over the Horizon

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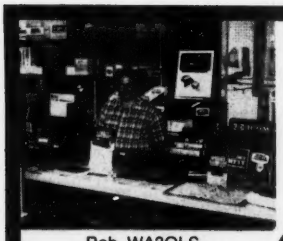

Rob, WA3QLS

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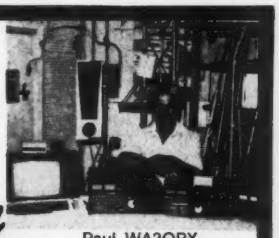
Amateur Supply



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CIRCLE 233 ON READER SERVICE CARD

Tool a Transmitter for AM Broadcast

Get a license-free slice of the spectrum

by Ken Cornell W2IMB

A beautiful 105 kHz slice of spectrum is available to experimenters with this simple, crystal-controlled transmitter. FCC rules governing nonlicensed transmitters offer some helpful information. A brief look at the history of the FCC rules governing nonlicensed transmitters (Part 15 Section 15:113) reveals that anyone can operate in the 510 to 1705 kHz range within certain limitations. In lieu of meeting the requirements of Section 15:111, a low-power communication device may operate on any frequency in the band 510–1705 kHz provided it meets all the following conditions.

(a) The power input to the final radio stage (excluding filament or heater power) does not exceed 100 milliwatts.

(b) The emissions below 510 kHz or above 1705 are suppressed 20 dB or more below the unmodulated carrier.

(c) The total length of the transmission, the antenna, plus the ground lead (if used) does not exceed 3 meters.

(d) Low-power communication devices that obtain their power from the lines of public utility systems shall limit the radio frequency voltage appearing on each power line to 200 microvolts or less on any frequency from 510 to 1705 kHz. Measurements shall be made from power line to ground with the equipment grounded and ungrounded.

Don't Give Up

In reading the above regulations, the first thought might be, "What chance would a transmitter running a tenth of a watt with a 10-foot antenna have against those high-powered broadcast stations?"

While it does sound discouraging, take a second look! The low end of the broadcast band ends at 540 kHz, this leaves the 510 to 540 kHz range relatively free of interference. At the high end, the present BC band stops at 1600 kHz leaving the range of 1600 and 1705 kHz fairly free of interference. Eventually this portion will be occupied by the expanded BC Band, but for the time being, it is a beautiful 105 kHz slice of spectrum!

Operation in the occupied portion of the band is strictly an area problem. Stations are separated by 10 kHz, and some stations do not operate 24 hours a day, or they operate with reduced power at night—so it is possible to find a few clear spots.

Eight years ago I ran a beacon on 1575 kHz with a transmitter made from a couple of bipolar transistors. My best DX was reception at 18 miles with Q5 copy. I am sure that my signal didn't "drop dead" a few feet further on!

The transmitter discussed here uses a simple, foolproof circuit with a couple of cheap ICs and a power VMOS, MOS or HEXFET RF amplifier. Using crystal control, there is only one tuned circuit: the tank/antenna coil. Another coil can adapt the oscillator circuit to VFO control.

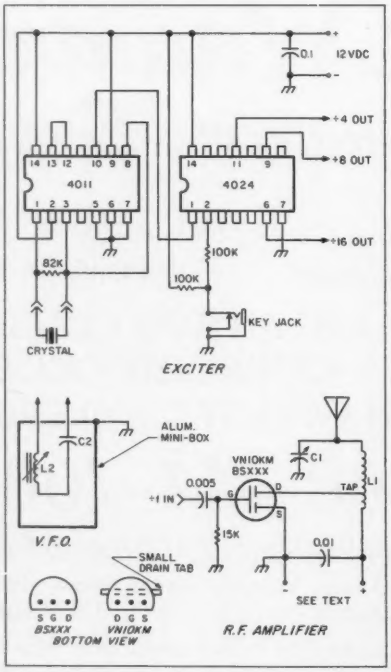

Figure 1. Medium frequency transmitter. NOTE: All resistors are ¼ watt rating and capacitors, 50 volts.

The circuit uses a CMOS 4011 IC as the oscillator. This is followed by a CMOS 4024 IC as a frequency divider, which permits the use of cheap, high frequency crystals. The final amplifier uses a Power MOS BS170, a Siliconix VN10KM, or International Rectifiers HEXFETs in the lower power IRFXXX series.

For operation on the 510 to 540 kHz range, use the divide by 16 output from the 4024—and for the 1600 to 1705 kHz portion, the divide by 4 output. See Table 1 for other available divided frequency outputs available.

The complete transmitter circuit is shown in Figure 1 with a suggested parts layout in Figure 2. All parts were mounted on a 2½" x 5" IC perforated board (holes spaced .100" x .100"), and sockets were used for the solid state devices. Since the circuit does not involve very high frequencies, simple point-to-point wiring will suffice.

Wind and Bolt

Plastic pill bottles 1⅜" diameter x 2½" deep make suitable coil forms. The snap-on covers for the bottles bolt to one end of the perf board. For the low end of the band, wind 210 turns of #30 enameled wire with the drain tap at 30 turns from the plus feed end. For the high end of the band wind 70 turns of #24 enameled wire with a tap at 10 turns. Drill two small holes side by side at each end of the coil form to secure the ends of windings. For mid-range, the number of turns can be evaluated by the two coils described; however, the drain tap must be 1.7th of the total from the plus feed end.

Since the 3m antenna connected to the end of the coil has minimal capacity to its ground system, a variable capacitor is required between the antenna connection and ground.

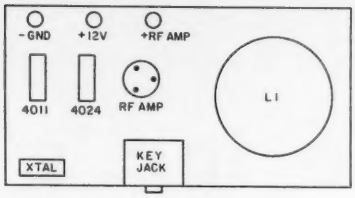

Figure 2. Layout of parts.

A 50pF trimmer capacitor will work fine.

Initial Tests

After assembly completion and wiring double checks, apply 12 volts to the exciter only (the two ICs) and clip a short length of wire to pin #10 on the 4011. Tune a receiver in CW position to the crystal fundamental frequency, and a loud beat note should be audible. Next, clip the wire to the desired divided frequency output and tune the receiver to the same frequency. Again, a beat note should be audible. If no audible beat notes occur, recheck the wiring and particularly all solder connections.

With the exciter operational, next check the entire transmitter. Connect the antenna, insert a VOM with a 50 milliampere range in series with the plus lead to the final amplifier, and feed about 5 to 6 volts to it. With the tank/antenna coil out of resonance, very little current will flow. Tune the coils' variable capacitor until the drain current rises as the circuit approaches resonance. Check the operational frequency with the signal strength meter on a receiver and tune for maximum signal strength. At this point, set voltage and current to 100 milliwatts. A field strength meter is a valuable tool for tuning up.

All Important Antenna

Location and construction of the 3-meter (9′ 10⅛″) antenna should command considerable attention. It should be in the clear and as far as possible away from trees and RF absorbing structures. Any supports should be well insulated. A good ground is desirable with radials or wire mesh, as well as a driven pipe. With the circuit shown, there is low and relatively harmless DC voltage on the antenna. A 0.1mF capacitor added at the antenna connection will eliminate this voltage.

Considering the broadcast interpretation of the FCC rules on the antenna size, I would consider any structure that can be confined within a 3m diameter by 3 meter high imaginary cylinder legal. The transmitter would be contained within or at the periphery of such a structure.

A self-supported antenna can be made from 6″ diameter stove pipe with 3 angle brackets at the bottom supported on stand-off insulators. Paint the pipe with a good rust inhibitor. The transmitter, of course, would be placed in a weathertight housing. Due to the low power of such a transmitter, remote control of the transmitter is no major problem. See Figure 3 for a suggested arrangement.

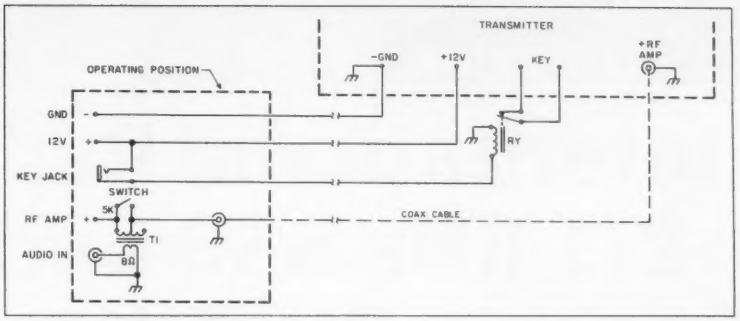

Figure 3. Remote control wiring. RY... 12 volt DC relay with normally closed contacts (SPDT can be used) T1... Audio output transformer.

In Section 15:133 the FCC requires that the following notice be placed on home-built transmitters:

I have constructed this device for my own use. I have tested it and certify that it complies to the FCC Rules Part 15. A copy of my measurements is in my possession and is available for inspection.

Signature_____ Date _____

Figure 4. FCC Mandatory Notice.

VFO Operation

The 4011 can be used as a VFO by replacing the crystal with a slug tuned coil in series with a capacitor (see L2 & C2 in Figure 1). Sixty turns of #30 enameled wire wound on a 5.16″ diameter slug tuned form in series with a 100 pF silver mica capacitor work well. A mini-box with an empty FT243 crystal holder at the end can serve as a mount. The coil and capacitor leads are not grounded to the mini-box and are connected to the crystal holder pins. This permits the VFO unit to be plugged into the crystal socket. A separate ground strap for the mini-box is provided for shielding. Using the slug for tuning, the VFO coil tunes 6030 to approximately 9,000 kHz which will cover the entire BC band using 4 to 16 divide positions. The 12 volts to the ICs should be regulated if a VFO is used. One advantage of using the divide by "X" circuit for a VFO is that any instability in the VFO is lessened by the division factor.

For AM modulation, I use a tube type audio output transformer with an 8Ω voice coil secondary. The primary (or ½ the primary if a push-pull type is used) is connected in series with the plus lead to the RF amplifier and the 8Ω output from a low power audio amplifier is connected to the 8Ω winding on the transformer.

For the power supply, I use standard handbook circuitry with a bridge rectifier, a 7812 for 12 volt regulation and a LM317T for variable voltage output from 2 to 24 volts for the RF amplifier.

To conclude, I might mention that I mounted the perf board containing the transmitter on short stand-offs on a larger piece of wood board to permit space for the notice that the FCC under Section 15:133 requires to be placed on all home-built devices. It also gives the transmitter some weight and stability.

While most of the common parts can be found at any well-stocked radio supply store, I suggest the following sources for hard to find components. Radio Shack–BS170 MOSFET (276-2074), Audio output transformer, 1k center tapped primary and 8Ω secondary (273-1380).

DIGI-KEY Corp., P.O. Box 677, Thief River Falls MN 56701-0677. 4011 & 4024 I.C.'s, sockets, IRF series of HEXFET's.

JAN Crystals, P.O. Box 06017, Fort Myers FL 33906-6017. FT243 crystals 2010 to 8900 kHz at $4.50 each. FT243 sockets at $.30 each. First Class mail and packing, add $.35 per crystal. 73

Operational Freq.	Crystal Freq.	Divided Freq.	4024 Pin No.
1600 x 4 =	6400	2	12
1705 x 4 =	6820	4	11
		8	9
510 x 16 =	8160	16	6
540 x 16 =	8640	32	5
		64	4
		128	3

Table 1. Typical crystal and resulting divided frequency values.

by Jim Thompson W4THU

Number 17 on your Feedback card

International Radio, Inc.'s 2.1 kHz SSB and 400 Hz CW Filters

They get the job done.

International Radio, Inc.
747 South Macedo Blvd.
Port St. Lucie, Florida 33452
(305) 879-6868
Price class: $150/pair (either SSB or CW)

The quality and performance of contemporary top-of-the-line transceivers leave little room for complaint. Top-notch performance requires triple and quadruple conversion schemes that use two or more filters for each mode of operation. The result is a marvelous arsenal of weapons for fighting QRM, but this weaponry is far from cheap. Because of the cost, most rigs include only basic filters.

Other companies beside transceiver manufacturers produce filters. International Radio offers SSB and CW filters in matched sets for most rigs. This review looks at a pair of International Radio's 2.1 kHz filters, which replace the standard 2.7 kHz filters in the Kenwood TS-930S. I also review here a set of 400 Hz filters from the same company.

A Few Basics

Multiple conversion schemes distribute filtering over several IF frequencies. There are sound technical reasons for this. In the TS-930, there are 4 IF frequencies. The signal frequency is up-converted to 44.93 MHz, which is followed by a 8.83 MHz IF. The third and fourth IF frequencies are 455 kHz and 100 kHz. Although there are filters at each IF frequency, the filters at 8.8 MHz and 455 kHz primarily determine the transceiver's IF response. An unmodified TS-930S has a high-quality 8.8 MHz IF crystal filter with a bandwidth of 2.7 kHz. The filter in the 455 kHz IF is a multi-pole ceramic filter. It's an excellent ceramic filter, but does not meet the standards of quality crystal filters.

Many casual CW operators don't install the optional CW filters available from Kenwood and others. They opt instead for the built-in audio filter and the CW VBT control, which provides a CW bandwidth variable from 2.7 kHz down to 600 Hz. This system uses the standard SSB filters supplied with the transceiver.

Although receiver selectivity is 600 Hz wide at -6 dB, the skirt selectivity is poor. Serious CW operators want the performance available from optional CW filters.

Installation

International Radio's matched set of 400 Hz bandwidth CW filters don't plug in like Kenwood's own filters do. The installer must cut two pins on the transceiver's main circuit board and solder connections to the new 8.8 MHz filter.

Since the insertion loss of the International Radio filters is slightly higher than Kenwood's filters, I measured receiver sensitivity to check for any degradation. With the International Radio 8.8 MHz CW filter installed, a 70μV signal yields an "S-9" meter reading and the MDS (minimum detectable signal) was less than 0.1μV (on 20m).

Installing the 455 kHz CW filter unit requires very careful soldering. This filter's location leaves little space in which to work.

After completing the installation of the 455 kHz filter, measurements were again taken, and the added insertion loss of the International Radio 455 kHz CW filter was +2 dB. The MDS remains in the 0.1μV range.

The International Radio 400 Hz CW filters work very well. The skirt selectivity is good, and there is no ringing. Figure 1 illustrates the bandwidth available at various settings of the CW VBT control. With this control set to the NARROW position, CW bandwidth is only about 100 Hz at -6dB and 400 Hz at -50 dB. However, since the TS-930S' CW VBT circuit is designed to work with 500 Hz filters, adjusting this control to its narrowest position (to attain the 100 Hz selectivity), will result in significant signal loss (greater than 15 dB). I found that setting the VBT no narrower than the 9 o'clock position produces a good compromise between signal loss and filter bandwidth.

Most of us relate to S-meter readings better

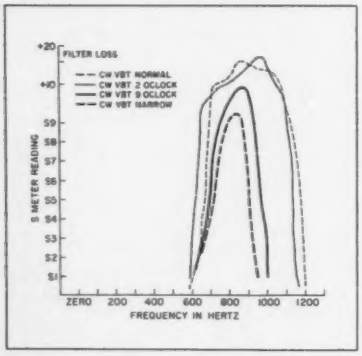

Figure 1. CW filter bandwidth at specific rotation points of VBT control.

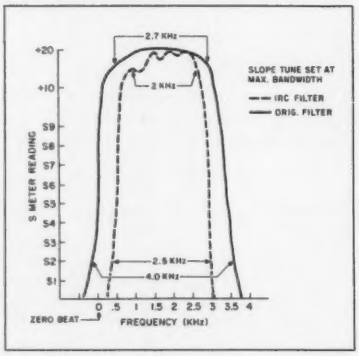

Figure 2. Slope tune, set at maximum bandwidth.

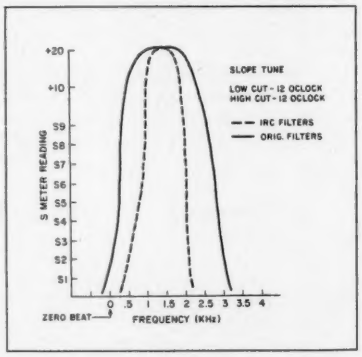

Figure 3. Slope tune, Low cut at 12 o'clock and high cut at 12 o'clock.

than a straight dB scale. The curves are referenced to the TS-930S' S-meter readings. These measurements can be without sophisticated test equipment. If you do not have a stable signal generator (a HP 8640C was used in this evaluation), you can use the 100 kHz calibrator as a signal source. Incidentally, with this particular rig, meter readings from "S-1" to 20 dB over "S-9" represent a range of about 50 dB.

I compared the original Kenwood filters with International Radio's replacements. I first installed a switching board, also available from International Radio. This board permits you to select either the original Kenwood SSB filters or the new filters while receiving. The transmission signal path is through the original Kenwood filters.

The Switching Board

Installing the SSB filters and switching board is a much more difficult task than installing the CW filters. It is not a plug-in and cut-a-jumper procedure. Since the original Kenwood filters remain in place, the new filters must find homes.

The switching board is not a necessity, and I recommend against using it as explained below. Simply swap the Kenwood filters with International's, then follow a brief alignment procedure to align the carrier frequency at the proper point on the newly installed filter's response curve.

Installing the switching board and the two SSB filters is a one-evening project. Progress is slow because of some ambiguity in the text of the instructions. International Radio assured me that new instructions are in preparation. I assume this will clear up the discrepancies.

Long coaxial cables connect filters to the switching board. There is just no room to mount the filters and switching board as a single unit. As it is, the combination of long coaxial cables, an unshielded board, and long, insufficient ground runs allow some extraneous pickup. The result is a continuous beat note heard when operating CW. This is most noticeable when the International Radio filters are switched into the circuit and the CW Broad/Narrow is in the broad position. However, even when the switch is in the narrow position and the 400 Hz CW filters are selected, the annoying tone persists, although much attenuated. Adjusting the notch control to passband center just makes the tone louder.

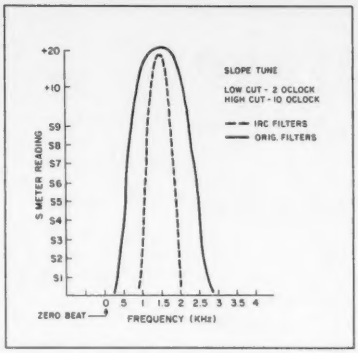

Figure 4. Slope tune. Low cut at 2 o'clock, high cut at 10 o'clock.

This ever-present tone is not acceptable. I definitely recommend against using the switching board if you plan to operate CW with your TS-930S.

This problem didn't occur with the original SSB and CW filters in place. Other TS-930S owners I know who use the International Radio filters haven't experienced this problem. None of them are using the switching board. This confirms the advice I gave in the previous paragraph. If you want the added performance the International Radio units can provide, replace the original Kenwood filters.

Conclusions

Serious DXers will probably like the narrow receiver response. The curves in Figures 2 through Figure 4 show the range of IF curves available at various settings of the TS-930S' "Slope Tuning" controls. Switching between the original Kenwood filters and those from International Radio make the TS-930 seem like a different transceiver. I both like and dislike the effect. It would be nice to have both sets of filters available. Most of the time, I prefer the naturalness of Kenwood's filters, even if they are a little too broad. The "Slope Tuning" controls are provided to permit you to adjust the IF response to best suit your taste or operational conditions. However, when the going gets really rough or I get down to the serious business of listening to a weak SSB signal through a storm of big signals, it's nice to have the new narrower filters in there helping out.

So, the choice is yours. If your operating needs require every bit of receiver performance you can muster, then these filters are for you. They get the job done! If, on the other hand, you are happy with your transceiver the way it came from the factory and you hear everything you want to work anyway, you probably won't enjoy giving up the velvet smooth audio quality of the standard filters. 73

Jim Thompson W4THU can be reached at 3207 Dogwood Drive, Portsmouth VA 23703 title (804) 484-0140

73 Book Review

Number 18 on your Feedback card

The Low and Medium Frequency Radio Scrapbook, 5th Edition

reviewed by Larry Antonuk WB9RRT

Written and Published by Ken Cornell W2IMB
8½ by 11, 138 pages, $15.00

My experiences with the "Experimenter's Band" all took place several years ago, in a high school electronics class. The big project of the year was a 170 kHz transceiver. It used several tubes, coils wound on paper towel tubes, and a strange collection of government surplus parts. The only hitch concerned the fact that I was the only student who actually completed his project. At the end of the year the instructor brought in his set—we had a short QSO over a distance of about fifty feet, and it was summer vacation. My 1750m station was put on a shelf, forgotten, and was eventually lost in the shuffle.

It's been quite a while since 1976, so the whole concept of the 1750m band was just a dim memory. Over the past several months I've been talking to more and more lowfers and I'm pleased to report that the unlicensed low frequency bands are alive and well, and filled with hundreds of hard-core experimenters. Many of these lowfers are also hams, reliving the early, exciting days of their radio careers.

A Closer Look

One of my more pleasant low-band discoveries was the existence of the Low and Medium Frequency Radio Scrap Book. Truly the current "bible" of low-band operation, this book covers every possible aspect of unlicensed operation.

If you've fallen into the practice of judging books by their covers, you'll need to look a little more closely in this case. The book itself consists of 138 staple-bound pages chock full of information, making it well worth the money. The book is mainly a construction manual, but a fair amount of information is given on the various bands available to unlicensed operators.

You'll find circuits for several transmitters and receivers, both tube and solid state. Wire, loop, and active antennas are discussed. If you need a simpler approach, build a transverter for your 80m rig. The fifth edition covers coils and coil winding in detail—other editions focus on various subjects. In addition to the construction information, there are sections on solar flare observation and ionospheric disturbance reporting. Once you decide to take the plunge, refer to the list of parts/radio/kit suppliers at the end of the book.

Two youngsters (of any age) could have a ball with this book. Whether you want to do across-town QSOs, beacon operation, or propagation studies, the Radio Scrap Book has something for you. Now, where did I put those empty paper towel tubes? 73

ABOVE AND BEYOND

VHF and UHF Operation

Pete Putman KT2B
3335 Fieldstone Dr.
Doylestown PA 18901

THE BEST AND THE WORST OF 1987

I know, I know. . . this was supposed to run in January. Things got a bit out of hand here with business travel and other projects. Better late than never!

The Best:

By far, Novice Enhancement. This might just be the turning point for the future of amateur radio. More hams mean more clout in Washington, and might mean fewer proposals to take away "unused" amateur frequencies for outside interests.

The Worst:

Easy. Docket 87-14, to delete the lower 2 MHz of 220 and reassign it to a service that doesn't need it so that service can employ a mode that is largely unproven to engage in communications that are unnecessary.

The Best:

An overwhelming assortment of equipment for Novices and 220 enthusiasts, largely due to Novice Enhancement and the efforts of ICOM who believed in the 220 market early on and made the commitment when others wouldn't.

The Worst:

Conditions during the January 1987 Sweepstakes.

A Close Second:

Conditions during the September VHF QSO Party.

The Best:

Conditions during the June 1987 VHF QSO Party. Operating 6 meters during this contest was like standing in the middle of a 20-alarm fire while the Pope holds a press conference, aliens are landing from outer space, and you are watching the Super Bowl, seventh game of the World Series, Stanley Cup and NBA finals for 36 hours. . . and trying to write it all down for posterity.

The Worst:

Mutek, Ltd. going belly up and out of the amateur business.

The Best:

The new IC-275/475A multimodes. They finally got the message.

The Worst:

Making reasonable airline connections from Newark (or anywhere) to Dayton '87.

The Best:

Yaesu's attempt to get hams interested in portable operation again with the FT-690R and FT-290R portables.

The Worst:

The increasing number of challenges to amateur antennas and towers by restrictive deeds, zoning and ordinances.

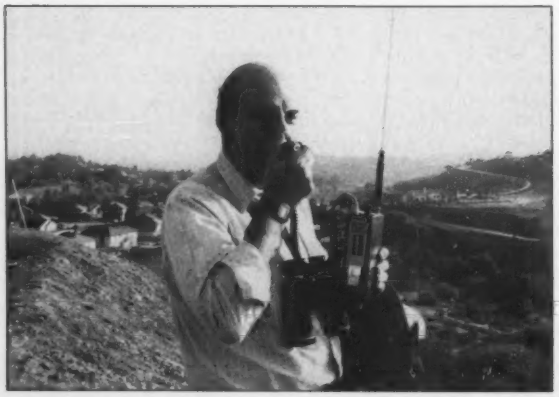

Photo A. Wayne Overbeck N6NB enjoys some mountaintop 6-meter operation with the Yaesu FT-690R.

The Best:

Those amateurs who persevered and won their cases with intelligent planning, good legal counsel, and judicious use of PRB-1 where needed.

Close Second:

Those amateurs who helped them win, whether financially or otherwise.

The Worst:

Those hams who didn't bother or didn't care.

The Best:

An antenna manufacturer who had the guts to admit they had a problem with their baluns and attempted to correct the problem, after stonewalling it for too long, thereby winning back a lot of respect from many amateurs.

The Worst:

Miller Lite and doughnuts for breakfast during a contest. Some of us never learn. . .

The Best:

Those of you who made an effort to (1) try a new VHF/UHF contest this year (2) added a new band to your shack (3) built some new rig or accessory (4) finally fixed that 10-year- old 6-meter yagi with half the elements broken. . .

And Finally:

The Best wishes for 1988 to all readers. Hope it's your year!

Travelling Down the Road

Yours truly had to make a short business trip out to Los Angeles recently, and I took a few extra days to stay and chat with Wayne Overbeck N6NB and his wife Debbie. Many readers will recognize Wayne's call for the many articles and books he's published on a variety of amateur and computer topics. Others will remember him for the famous cross-country jaunts he took as K6YNB to put several states on the air for 2-meter EME. Still others will recognize the call as the one that dominated VHF contests in the single/multi class during the 70s.

Yep, Wayne's a busy guy. Shortly after I arrived, we hiked up to a hill west of Tustin to try a little 6-meter FM work with the FT-690R and a whip antenna. Contacts were quickly made on 50.300 simplex with members of the Southern California Six Meter Club (thanks for the monthly newsletters, folks!) over surprising distances. With a pipsqueak 3 watts, we worked well up north to the San Fernando Valley as well as around L.A. itself. There was so much smog that I couldn't see the city, but the radio reports assured me something indeed was there!

Wayne is currently Vice Director of the ARRL Southwestern Division, and is quite active in promoting the hobby and speaking before clubs in his division. He is a professor at Cal State Fullerton and the University of Southern California, where he lectures in communications law. In addition, Wayne and Debbie enjoy buying older homes and fixing them up, which keeps them very busy. Add to that Wayne's continuing interest in VHF/UHF DXing and contesting, there's not much time left over!

"More hams mean more clout in Washington."

Wayne is also somewhat famous for his tower-on-a-trailer designs, ready to head off to the nearest peak at the drop of a hat. Right now, a Tri-Ex LM-470 crankup atop a custom mobile trailer occupies a good part of his driveway.

It's quite possible that Southern California is the most difficult place to erect a tower with respect to deed restrictions and zoning. While we were out driving along I-5 to San Clemente, Wayne pointed out town after town and development after development where towers weren't allowed. Quite depressing! It seems you have to buy in an older community to even think about a tower.

I did mention contests, right? Wayne hasn't been too active lately, but in the 70s he copped national first place in the June contest from 1973 to 1977, consecutively, and the September contest from 1975 to 1977. In fact, Wayne has pulled off a #1 finish nationally 12 times over the years in VHF contests. This guy really takes his hamming seriously! I called Wayne a few days afterwards, and he'd just come down from Saddle Peak after working a tropo opening into Hawaii on 2-meter sideband.

Antenna Parties

You know, the kind where there's lots of beer and munchies

Photo B. Dave Porter K2BPP atop the 40-ft level, getting ready to put up the last 10-ft tower section.

afterwards? Well, I went to one of these at Bill Radice K2OWR's place in Liberty Township, NJ, a few weeks ago. Bill lives up on a 900-foot ridge with terrific views in virtually every direction, and he's put up an impressive collection of towers and antennas. The day I arrived, he, Dave Porter K2BPP, Leroy Sliker KA2UHS, and Steve Katz WB2WIK were topping off 50 feet of Amerite tower with a 5-element HyGain "clone" for six meters. The weather was just right...sunny, cool and lots of wind! Well, it seemed like it when I climbed the 70-foot Rohn 25 tower to get a few photos of the site.

Bill is an old-time VHF operator, first licensed in the late 50s. He was quite active on 6, 2 and 220 AM in the 60s and contested as part of the old Interstate VHF Society (WB2GKE) along with Steve and many others. They staged many an operation from Sheep Hill in Boonton, NJ, and the call-sign K2XR was more often than not atop the standings for the Hudson Division in January, June and September.

Bill's getting back on in a big way from his new "modular" QTH! On 2, he runs a pair of 4CX250Bs to 19 elements for a whopping signal, and two stacked FO-22 yagis with 100 watts do the trick on 432. A 4-bay array of F9FT 23-element yagis and a single 7289 get out quite well on 1296. It was only logical that he get back on 6 meters with an MMT 50/28 and outboard amplifier. Look for him this year in the various contests! (Now if he would just put up the 14-element yagi I left there and get on 220 MHz.)

News, News, and More News

The National Contest Journal (NCJ) added a regular feature on VHF/UHF contesting. It's co-written by Curt Roseman K9AKS, Mike Owen W9IP and Emil Pocock W3EP, and contains some very useful observations. Whether you are a serious VHF contester or just getting your feet wet, I suggest you take out a subscription. It's available for $10/year (6 issues) from the ARRL, 225 Main Street, Newington CT 06111.

The Cuyahoga Falls Amateur Radio Club is sponsoring the Crazy 8's HF, VHF and UHF contest to be held from 1400Z February 6 to 2300Z February 7, 1988. Hams outside the 8th call area work only 8s, hams inside work everyone else. Multipliers on HF are State, Province or DX Country; on VHF/UHF they are grid squares. All bands from 1.8 to 1296 MHz are valid except 10 MHz. All modes are acceptable, including repeater and satellite contacts! The list of multipliers is too long to mention here, so if you want to give it a shot, write Anthony Luscre KA8NRC at 5441 Park Vista Ct, Stow OH 44224 for more information.

Harry Schools KA3B is continuing with his excellent compendium of 6 meter data, stories and anecdotes. I've received issues #2 and #3 recently and there is a wealth of information regarding the earliest 6-meter trans-Atlantic contacts as well as a trip down memory lane with old antennas and radios. If you have the slightest interest in this band, these are must-reads. Harry states that he cannot run a full-time subscription and printing operation, but will circulate as many copies as he can to prominent 6-meter operators around the world with the hopes that they will make it available to others. If you'd like to correspond with him, he can be reached at 1606 S Newkirk Street, Philadelphia, PA 19145.

A Towering Victory

Readers will recall the rotatable DX86 tower featured in September 1986 73 magazine ("A Rotatable What?"). Mike Crawford WA2VUN, whose handiwork is mentioned here from time to time is finally able to have one in his backyard after a year's blood, sweat, and tears.

Mike's neighbors took exception to this "monstrosity" marring his landscape, and dragged him into a series of hearings before the West Caldwell, NJ, Board of Adjustment. Mike retained Robert Cherry K2HBX as his attorney and wound up preparing exhaustive engineering studies of the sturdiness of his project. He also had to satisfy to the FAA that his tower presented no obstruction to aircraft and required no markers. All this was the result of his neighbor's attorney's actions to find a way to get it removed.

Mike did it the right way, and prepared for the final hearing by obtaining public information packets from the ARRL a month before and distributing them to all seven board members. The FAA inquiry was also resolved in his favor (no obstruction, no lights), and the overwhelming evidence presented in the engineering studies proved (in essence) that the tower wasn't likely to fall over unless Armageddon was upon us! Bob asked me to testify if needed at the hearing on Mike's need to have such a tall tower for adequate communications on VHF/UHF bands.

"There was so much smog that I couldn't see the city, but the radio reports assured me something indeed was there!"

Bob also circulated copies of PRB-1 to the town's attorney as well as his neighbor's attorney, so both were aware that some accommodation had to be reached. The night of the hearing, which didn't start until 10:30 PM and ended nearly at 1 AM, his neighbors made a proposal to drop their complaint if Mike would agree to plant 12-foot evergreens across the back of his property as a screen. All parties concerned agreed in principle to this, and then it was up to the Board to grant the necessary variance for the existing 110-foot structure. I got my chance to testify and, as luck would have it, the town retained as their own expert witness a local Extra-Class amateur (and engineer) who was a town councilman.

Mike won the case in every respect. He'll have to shell out a few bucks for the trees, but that's cheap insurance to keep his labor of love intact. Now he can crank it up without fear and get that 8877 fired up on 6 meters!

QRV on 903

Last but not least, I've finally added 903 MHz to the station here with the SSB Electronics LT-33S, about the only commercially-made piece of equipment for 903 on the amateur market. They're not cheap either, with the devaluation of the dollar boosting the price to a hair under $600. If you're disinclined to "roll your own," however, it's the only way to fly. I also ordered one of the Down East Microwave 33-element loop yagi kits for 903 and will have a review of it soon.

I plan on operating as many of the major contests as possible from mountaintops and rare grids on 903, 1296 and 2304 this summer, so I'll be looking for those readers who need such grids as FN22, 23 and 24, FN 34, and FN14 on these bands. More details on this type of operation will appear in this space soon. Until then, see you Above and Beyond!■

Photo C. K2OWR's shack in repair. He's very active on 144, 432, and 1296.

Helping and Hopping the HW-9

A few adjustments to make this QRP rig really perk.

by Terry F. Staudt, L.P.E. WØWUZ

In the summer of 1986, financial circumtances forced me to sell my FT-101ZD and MLA-1200. The ZD had Fox Tango filters plus other goodies, and I fully intended to keep it until the wheels fell off. In short, I was perfectly satisfied. The only consolation is I received an excellent sum when I needed it badly.

In May of last year my condition improved and with the "bug" biting my ankle off I was faced with the dilemma of buying someone else's problem that looked like it'd been kicked off a bridge, or starting from scratch. With a little remorse, I decided to go for a QRP rig and make the best of it.

I've had Heath products on and off since 1954 and was generally satisfied with them (although I could never keep my sticky fingers out of them). The HW-9 was on sale at the time, so I decided I probably couldn't go wrong and picked one up along the WARC band kit. I'm very glad I did—30 and 12 meters are fun bands.

The HW-9 was covered in the "QRP" column in July 1987 and reviewed by WB8VGE in August. While it was showered with flowers except for the vernier drive problem, nothing was said about some very obvious shortcomings.

I'm going to go through these and the inexpensive solutions, with a tip of the hat to Matt Adrian, senior technical consultant at Heath, who was very candid in response to a very detailed letter I sent.

First Things First

First of all, the vernier drive. This is a dreadful little thing that has all the torque of a mouse's tail. The only way to avoid having to replace the darn thing over and over (a crummy job), is to follow the installation instructions TO THE LETTER. Then, oil the brass reduction gear on the capacitor and give it a generous coating of office equipment or sewing machine grease. You really can't use too much. As stated in the manual and by

Photo A. The Heath HW-9 QRP transceiver.

WB8VGE, do *not* force the dial past its upper and lower stops. About the fourth time you do this, the vernier rolls over and dies. Heath is acutely aware of the problem and will replace it over and over until they obtain a better device.

VFO Improvements

The second issue is VFO drift and calibration. As stated by WB8VGE, this is a trial. The trimmer on the main capacitor and the slug in the coil move in lock step with each other, so you wind up chasing your tail. Having been involved with design engineering for some time, it bacame quite apparent that the mix in the VFO tuning slug had too much permeability. It's a bit much when you blow hard on a "diddle stick," and the frequency changes 2 kHz.

I'm lucky that I have plastic drawers full of

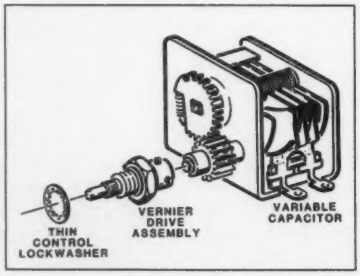

Fig. 1. The position of the vernier drive assembly.

cores pulled from junked TVs and other appliances. Even though their cores weren't coded, I felt a red or preferably a yellow mix was called for. (The yellow is the most stable, however it's generally used from 10 MHz to 40 MHz—the VFO is 5 MHz). Well, a ⅝" yellow slug did the trick and the frequency changes "smooth and greasy," as it should. It also cut the drift from about 3 kHz in 8 hours to 950 Hz. As for the linearity, there is *one* slotted plate on the VFO cap that a little judicious bending with a jeweler's needle-nose pliers will yield ± 2 kHz accuracy over the dial except for each end where it tends to lose its mind by about 5 kHz.

The VFO capacitor is grounded through the planetary gear and vernier drive, which causes a "swish-rustle" sound when tuning. Solder a piece of wicking to the capacitor frame through the "U" cut, through which the VFO coax passes. Then solder another piece of tinned shield where the first was soldered to the VFO coil shield can. This also drops the birdies substantially.

During assembly, I painted the inside of the VFO coil shield with flat black 'hobby' paint. The reason for doing this was simply the fact that it was so bright you could shave in it. One doesn't need any infra-red reflection in this area!

The IF and AGC

Although the receiver has no RF stage, the IF is hotter than a $2 pistol. In fact, it has to be de-tuned slightly (manual instructions) to keep from oscillating. Still, though, the almost total lack of background noise from 15 meters up bothered the heck out of me. Investigation turned up two problems. The first mixer, Q107, and MFE-131 dual-gate MOSFET had an injection drop-off rate of about .8 Volt per band as it went up. A quick look at the specs on this device showed it to be a bit of a wheel horse as these things go. Being very well acquainted with the 3N211 and having a few on hand, one was tried and voila! The

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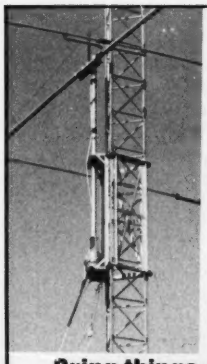

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By Bob Grove
WA4PYQ

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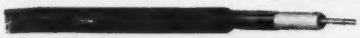

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beginning of atmospheric noise. Not a lot, but it was definitely there switching between an antenna and dummy load. Now there was light at the end of the tunnel. (3N211s can be found at Fox Tango. I also am sure a 40673 would work about as well).

I found the AGC time constant to be much too fast. Evidently they didn't want to lose a 'dot' at 70 WPM. After watching the S-meter act like a geiger counter for a few days, I changed R312 from 47K to 150K and C317 from 3.3 to 6.8 μF. These are the resistor and capacitor that determine the AGC decay time and the values I used bring it up to 1.02 seconds. I now find it satisfactory, but it can easily be stretched out with a bit larger cap.

To liven up the S-meter, break the ground lead to R323 and add a 10K potentiometer in series. This allows the operator to adjust the meter's sensitivity for more realistic readings.

Also, reading relative power out on the meter is troublesome. Replace R431 with a 25K potentiometer and adjust it accordingly when transmitting into a dummy load.

Moving Right Along

The QSK circuitry of the HW-9 involves a whole lot of diode steering, but the almost essential feature (I hate relays) does introduce some losses. Here, Heath takes it on the chin by using the same old "carload" diodes everywhere. When Radio Shack sold Hewlett Packard 5082-2835 Schottkey diodes at two for $1.99 (276-1124), I bought a whole bunch. I replaced D301, 302, 403, 404 and 407—all in the RX RF path with them and an S-2 reference signal on 10 meters went to S-8. Now the receiver is a going proposition. (1N295s would be suitable if you don't have Schottkey's.)

Removing the T/R board looks like a project to be given a lot of thought and 807s. It's really easy once you know how. With the top and bottom covers removed, unsolder the blue wire from the key jack. With the unit on its top and rear facing you, remove the rear panel (6 Phillips screws). Remove the bandswitch shaft and put the retaining collar in a safe place. Then remove the ¼" nuts from the T/R board. Place a washcloth over the front panel for scratch protection. Now lift the T/R board from the rear, setting it vertically, and simultaneously gently lay the rear panel over the front.

Final Points

The transmitter, while really very good, had just a few problems. Again, very easy to solve. The first thing was the inadequate heat sinks on Q405 and 406 PAs. The finals are TO-5s and the sinks are tiny two finned "top hats." They run hot, and they'll eat up your fingerprints without a burp. I lost a pair of finals (I used thermal compound—Heath does *not* supply it) and not wanting it to happen again looked in vain for better sinks. They're in catalogs but nobody carries them. I finally found some U-shaped beryl TO-220 sinks with slotted fins at Gateway Electronics, a surplus house in Denver. Bandswitch shaft clearance is a factor here. After careful physical alignment, I super-glued them to the tops of the existing "hats". Now I can touch them all day—they just get warm.

The other problem was instability on 15 meters. While advancing the TX level control the meter would suddenly slam "hard right," and the frequency counter would go nuts. I remedied this by adding a little emitter bias (.7Ω, three 2.2 Ω resistors in parallel on each PA). Now, *here's* a problem Heath is aware of. Whew! TX transistor Q402 is being changed to Heath part #417-293 (2N5770) and Matt Adrian advises all HW-9 owners to send for one. It's free whether the unit is in warranty or not.

In summary, would I buy it again? I sure would. For a few bucks worth of refinement which can be done during assembly (which is no snap), and a *decent* antenna, this puppy will work anything you can hear. The selectivity is excellent, as is the RIT.

On the whole, you can't beat it for pure fun. Enjoy. 73

Terry Staudt W0WUZ has been a ham since 1954, and has contributed to the pages of 73 *since 1961. He enjoys rag-chewing DX (almost mutually exclusive!). A licensed professional engineer, Terry consults for TV and radio stations nation-wide and is a senior technical editor for* Monitoring Times. *He can be reached at 716 N. Roosevelt Ave., Loveland CO 80537.*

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CIRCLE 152 ON READER SERVICE CARD

from page 24

1750 METER TRANSVERTER PARTS LIST

Resistors	(Ohms)	Resistors	(Ohms)	Resistors	(Ohms)
R1, R26	470	R9, R20	51	R29	4.7
R2, R11, R12	47	R10	560	R30	1.0 1Watt
R3	82k	R13–R18	300 2W	R32	2k PC Pot
R4	22k	R19	2.5K 1/2W	R33, R41	4.7k
R5, R31, R36	1k	R22	1.5k	R34	680
R6, R24	270	R23	33	R35	100
R7, R21, R27	2.7k	R25	180	R37, R38	2k
R8	6.8k	R28, R39	10	R40	10k PC Pot

All resistors are 1/4 watt, unless noted. K = 1000, all pots are linear type, printed circuit top adjust.

Capacitors

C1, C2, C4, C19	.01 50 Vdc Min. Polystyrene
C30, C31	.01 50 Vdc Min. Polystyrene Radial
C3, C20	.005 16 Vdc Min. Polystyrene
C5, C7, C12–C14, C33–C35	.1uF 50 Vdc Monolythic
C9	25pF Variable "highQ" type
C15	820pF Silver Mica
C16	.001 250 Vdc Min. Polystyrene
C17, C23	1uF 50 Vdc Electrolytic
C18, C21, C22, C24	4.7uF 35 Vdc Electrolytic
C25, C32	10uF 16 Vdc Electrolytic
C26–C29, C36, C37	2.2uF 50 Vdc Electrolytic

Transistors, Diodes, Misc

Q1, Q4	J310	Q6	2N2102	HS1	Q7	Heatsink
Q2, Q3	2N2857	Q7	TIP31A	HS2	Q6	Heatsink
Q5, Q8, Q9	2N2907					
Q10, Q11	2N2222	Q12	LM7812CT			
MX1	SBL-3	D1	1N4001			
K1, K2	DPDT PC Relay	D2, D3	1N914			
Y1	3.4995 MHz Crystal. .005% Tolerance .32 pF load. HC-18/U type case.					
F1A	1 Amp fuse "fast acting"	F1B	Fuse holder			

Transformers, Chokes, Coils

L1, L2	27.5uH Amidon T-44-3	39 turns, #28 Enameled wire
L3	4.7uH Choke	
L4	100uH Choke	
L5	3.3uH Inductor	
L6	180uH Amidon FT-50-61	54 Turns, #28 Enameled wire

T1 55 Turns Primary, 16 Turns Secondary. Primary uses #28 Enameled Wire, Secondary uses #30 AWG Wire Wrap type wire wound evenly over primary. Use Amidon FT-50-75 Toroid.

T2 55 Turns Primary, 6 Turns Secondary.Primary uses #28 Enameled Wire, Secondary uses #30 AWG Wire Wrap type wire wound evenly over primary.Use Amidon FT-50-77 Toroid.

T3 50 Turns of #28 Enameled Wire, twisted pair aprox. 4 or 5 twists per inch.Wind tightly and evenly over an Amidon T-68-3 Toroid.

PARTS ACQUISITION

K1, K2	Digikey Z304ND	MX1	Minicircuits SBL-3
L4	Digikey M7101	L5	Digikey M8019
Y1	Jan Crystals	R30	Digikey 1.0W-1
R32	Digikey SOG23	R40	Digikey SOG14
HS1	Digikey HS115	HS2	Digikey HS101
C17, C23	Digikey P6749	C18, C21, C22, C24	Digikey P6752
C25, C32	Digikey P6746	L3	Digikey M8021
C26–C29, C36	Digikey P6750	F1B	Digikey F002-ND
F1A	Digikey F115-ND	C30, C31	Mouser 23PW310
C1, C2, C4, C19	Mouser 23PS310	C3, C20	Mouser 23PS250
C16	Mouser 23PS212	C15	Mouser ME232-1900-820
C9	Mouser 530-189-0509-5		

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Continued from page 31

Experimenter Band Beacon List

FREQUENCY (kHz)	CALL	QTH	SKED
160.025	MAX	Wheatland WY	24 hrs/7 days
			CW, BPSK/ACII BR
160.800XX	NH	Monroeville NJ (FM29)	Occ. Secondary beacon, see MOO
163.93	AVV	Independence OR	Off air
163.930X	MSG	Paso Robles CA	Intermittent
164.44	D	Des Moines IA (EN31)	24 hrs/7 days
169.863XX	1SUN	Durant OK (DM23)	24 hrs/7 days
171.000XX	CB	Portsmouth NH (FN43)	24 hrs/7 days
172.38V	1LM	Plymouth MA (FN41)	24 hrs/7 days
174.39	SUK	Eldorado Hills CA	24 hrs/7 days
174.800X	8TXT	Sandusky OH (EN81)	BR
174.527	3KLR	Glenside PA (FN20)	24 hrs/7 days
174.85V	7FS	Montesano WA	On air soon
175.00X	HG	Toledo OH (EN81)	Nights
175.350XX	GEO	Wintergarden FL (EL98)	24 hrs/7 days
175.388XX	KRY	Chardon OH (EN91)	Off for summer
175.472	MUK	San Luis Obispo CA	TO
175.70	ARK	Leslie AR	Off for summer
175.703	FAW	Orem UT	24 hrs/7 days
175.85	R	Utica MI (EN82)	24 hrs/7 days
176.000X	HDO	Morro Bay CA (CM95)	24 hrs/7 days BPSK/ASCII
176.263	CO	Glenwood Springs CO (DM69)	24 hrs/7 days
176.30	BA	Lancaster IL (EM68)	On air soon
176.46	6RDJ	So. Whitley IN (EN71)	Weekends
176.925	HB	Hamden CT (FN31)	24 hrs/7 days
177.00	DA	Braintree MA (FN42)	Occ.
177.00K	KJ	Chicago IL (EN81)	24 hrs/7 days
177.2	ABK	Akron NY	Weekends
177.26	NVA	Pahrump NV	Off for summer
177.506	UCP	Saratoga CA (CM97)	1400 to 1700 GMT daily
177.520	DW	Middlesboro MA (FN41)	Weekends
177.750S	CT	Flagstaff AZ (DM45)	24 hrs/7 days BPSK/ASCII
178.0+1V	N	Maiden NC (call change)	24 hrs/7 days, 19 N's/min.
178.977	TIM	Pitman NJ	Occ.
179.000	MPM	Salt Lake City UT	24 hrs/7 days, BPSK/ASCII for 5 mins., CW 5 mins., alternately.
180.030	NTD	Oakland FL (EI98)	24 hrs/7 days
181.168	IZJ	San Gabriel CA	Daily, silent 0700-1100 GMT
182.00X	ZZZ	Loretto TN (EM65)	24 hrs/7 days
182.270XX	G	Palo Alto CA (CM97)	TO
182.62	FPV	Granada Hills CA	24 hrs/7 days
182.900XX	Z2	San Simeon CA	24 hrs/7 days
183.160XX	PRK	Saratoga CA (CM97)	24 hrs/7 days
183.65	PLI	Toluca Lake CA	24 hrs/7 days
184.016	EK	Sunnyvale CA (Cm97)	24 hrs/7 days
184.320X	JR	West Hartford CT (FN31)	24 hrs/7 days, remote beacon
184.380	HO	near Hilo HI	Off air
184.500	JKS	San Anselmo CA	24 hrs/7 days, BPSK/ASCII
184.599	Q	Boulder CO	24 hrs/7 days
184.750XX	1SNH	Waltham MA (FN42)	1100–0100 WD/ 1100–2400 WKN 174.75
184.795XX	MEL	San Jose CA (CM97)	24 hrs/7 days
185.00	ZYK	Redway CA	24 hrs/7 days
185.410XX	XMGR	Cleveland TN (EM75)	24 hrs/7 days
185.49	AZ	Tucson AZ	24 hrs/7 days
185.50	UM	Rehoboth MA (FN41)	Occ.
186.404XX	HRM	Oakland NJ (FN21)	24 hrs/7 days
186.900XX	DBQ	Ft. Washington PA (FN20)	TO
187.000XX	KP	Murraysville PA (FN00)	BR and occ. Weekends
187.000X	OMG	Treasure Island FL (EL98)	TO
187.006VX	OWR	Paso Robles CA	On air soon
187.04	TUG	Bel Air MD	Occ.
187.263	Z2	San Simeon CA	Weekend Days. This is the SKY station of Z2, horizontal polarization
187.30	UPN	Cincinnati OH (EN79)	Off for summer
187.50	J	Los Angeles CA	24 hrs/7 days
187.50	KEN	Pt. Pleasant Beach NJ	1000–1230 and (FM29) 2200–2400 GMT
187.50	RM	Duluth MN	24 hrs/7 days
187.56X	JM	Broken Arrow OK	Off for summer
187.594XX	SM	San Jose CA (CM97)	24 hrs/7 days
187.700SK	SD	East Haven CT (FN31)	Occ.
187.846XX	XY	Kearny NJ (FN20)	24 hrs/7 days
187.900XX	MOO	Monroeville NJ (FM29)	Weekends
188.470X	9HDQ	Daleville IN (EN70)	24 hrs/7 days (back on air)
188.700SK	WI	Owings MD (FM18)	24 hrs/7 days
189.00	JUG	Cincinnati OH (EM79)	24 hrs/7 days
189.210XX	QYV	Donora PA (FN00)	24 hrs/7 days
189.380XX	TH	Colts Neck NJ (FN20)	24 hrs/7 days
189.56VK	1RB	Foxboro MA (FN42)	Off for summer
189.700XX			
189.725XK	GHK	Palm Bay FL (EL98)	24 hrs/7 days
189.729XX	8LXJ	Morrow OH (EM79)	Off for summer
189.80XX	NTS	Mercury NV	24 hrs/7 days
189.834X	ABC	Hilton Head Islands SC (EM92)	24 hrs/7 days

NOTES: Column 1—Frequency, Column 2—Identification, Column 3—Location, Column 4—Grid, Column 5—Operation schedule. X—Crystal control, S—Synthesized, V—VFO, frequency may vary. K—Progammable Keyer. BR—By request. Occ—Occasionally. TO—Temporarily off air.

Thanks to Brice Anderson's On the Air.

ATV

Ham Television

Mike Stone WB0QCD
PO Box H
Lowden IA 52255

Ham QRP TV

One of the most successful Amateur Fast Scan TV low-power, transmitters is PC Electronics Model KPA5 "Kreepy Peepie" module. It's been out on the market with just a few minor improvements for over two years now.

The module is a circuit board, and all the parts are assembled and aligned by the Arcadia California factory facility. The buyer needs only to put the module into a case, add a few switches and holes for connectors, and begin to have fun with low-power ATV! The KPA5 unit measures about .5–.6 watt out on a Bird 43 wattmeter (using a 10-watt 400 MHz slug) on an averaged video-content picture-modulated image. It passes good color and sound signals. The small 3.25" x 4" size fits anywhere, and needs only a 300 mA, 13.8 VDC supply. It can be crystalled-up for one or two transmitting frequencies. The most popular ATV frequencies are 439.25, 434, and 426.25 MHz.

Microphone input takes a low-Z dynamic type, and there's also a line audio input. The unit can be used as the foundation for a large base-station exciter (with a higher power amplifier) or for direct uses such as remote-controlled aircraft or other vehicles, portable parade, or special event remotes, remote transmitters, repeater transmitters, link transmitters, robotics, security monitoring, etc. A donated PC KPA5 unit flew 1000 feet on last summer's Ohio WB8ELK helium-filled balloon special event!

The KPA5 sells for just $159.

1-Watt ATV Transceiver

The TC-70, a complete one watt ATV transceiver system, is also available from PC. It is an attractive unit mounted in a Ten-Tec style box. The TC-70 has a sensitive UHF GaAsFET tunable downconverter (for receive) and standard 4.5 MHz FM audio subcarrier injection. You can hook up your 10-pin VCR camera directly with no need to adapt plugs or cut off connectors. The TC-70 runs about $300.

Don Miller W9NTP of Wyman Research in Waldron, Indiana, has similar offerings in his line of FSTV equipment. In the November 1987 issue of SpecCom Journal (Volume 17 No. 9), Don announced a new Milliwatt Hamband ATV Transmitter ($60). These units are very low-power and good for certain home applications. Wyman also has a one watt transmitter and transceiver package. The WR-450 transceiver sells for $300. It has a few more features than PC, including on-carrier sound. Both competitor's units work very well.

I suggest you send SASEs to both companies. Tell them my column in 73 Magazine sent you.

New ATV Nets on 20 and 75 Meters!

Bill Brown WB8ELK and I kicked off an FSTVers Coordinating Net every Tuesday evening on 3.870. It's very well attended. We can actually be found somewhere between 3.860 to 3.870 MHz on the 75-meter band. Finding a clear frequency is often nearly impossible. There's an early net at 8 p.m. EST, controlled by WB0QCD. The late net's on at at 10 p.m. EST, controlled by WB8ELK, or WA4UMU in South Carolina. Besides some good check-ins covering the East Coast and most of the Midwest, some technical discussions get going among members of AVT groups and clubs about antennas, the video signal, DXing, etc.

Why not join in on the fun? We need representatives from all ATV clubs and groups in the country to check in and report about their local activity. A similar net on 20 meters is evolving with Dr. John Fox WB2LLB/4 in Alabama. Tune into 14.235 MHz on Sunday afternoons at 2 p.m. EST. John is mixing FSTV discussions with SSTV pictures.

Marty WD0BCE from The Davenport, IA, BRATS ATV Club was having a lot of fun running around the Quad-Cities "portable ATV" using a Radio Shack (Citzen) LCD Quartz mini-TV set! Gobble up these TV7s folks as we have found out that they go all the way down into the 421 MHz region on UHF just below Channel 14! Very few TV sets do that all. Yes, TV shortwave and monitor buffs, that means you can "tune-in" to local FSTV action without the need for a downconverter device. You will need a good antenna system though and maybe even a preamp unless you are very close to source. Sending and watching low-power ATV signals is FUN!

Super VHS Is Here!

Ready to buy a new VCR or CAMCORDER? SUPER VHS is here! Shown on the Today Show, December 4th, 1987, SUPER VHS offers nearly twice the definition as standard VHS pictures. Over 400 lines are represented on the TV screen (standard commercial TV is 525 lines in America). I have seen a demonstration and SUPER VHS is going to be the standard for all others to shoot against for I would say the next 10 years. Judge your pocketbook accordingly. For most of 1988, SUPER VHS will be expensive. Some good buys will become available on the old standard VHS systems. Now is the time to jump in and get yourself either a low or high grade unit!

14.240 MHz on weekends is where you will start hearing more of those shrill tones called amateur facsimile. The recent announcement by AEA of a new PK-FAX software program for PK-232 and IBM (and clone) users for FAX picture video TV screen receive and transmit has opened up a lot of new possibilities. I was asked to play around with AEA's new software and give them my feelings about what they had developed. I am helping them now for some great future projects at AEA. Users of FAX are scarce—but they are around. Greg Mengel took over the editor's position of the Environmental Satellite Users Group publication and will soon be promoting FAX transmit capability on all bands. There has already been a fair amount of exchange done in the past couple of years using computers and dedicated FAX machines. Japan leads the world in FAX hobby use. They can be heard on 14.240 Mhz during early morning hours.

ATV Frequency Coordination

There is a growing problem today with some established state frequency coordinators tackling the complicated responsibilities of sensible spectrum management when it comes to FSTV on UHF. The USATVS has heard a number of reports of gross discriminations by state frequency coordinators against ATVers.

Part of this has been our own fault! We haven't organized and been there to help them make these decisions in our favor. Tom O'Hara W6ORG has been hollering about this for years as has been the old A-5 publication. We need your help! Register your system with your state coordinator at once! Many state frequency coordinators have improperly assigned FM links and repeaters to slots alloted to ATV according to the ARRL band plans.

ATVers didn't speak up and they got away with it for awhile. They worked simplex for many years at 439.25 MHz and then recently decided to build up an in-band 70cm ATV Repeater system. They got a rude awakening when they filed to coordinate the 421 and 426 MHz output channels. If you are having a problem like this, whatever the cause, write to the USATVS for help.

A "Frequency Coordinator's Guide to Placing ATV Signals with Guard Channels" package is available from the USATVS, which may help you with your ATV problems. Copies were mailed to all listed frequency coordinators recently. These situations must be addressed. I spoke several times with Dave Sumner K1ZZ at the League about the coordination problem, but the League doesn't feel it can address the issue since they do not themselves coordinate or sponsor coordinators.

Who coordinates the coordinators? The League or the FCC will eventually have to address this worsening issue.

Spring is just around the corner! Are you beginning to make plans for Dayton? We will be at The Ramada Inn North with our ATV Workshop once again on Friday and Saturday nights. The room will be crowded, so you better come early to get a good seat. See you on one of the ATV NETS on 20 or 75! 73

"Who coordinates the coordinators?"

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CIRCLE 175 ON READER SERVICE CARD

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- Some repeaters also have weather radar, Space Shuttle video, BBS, & computer video

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Tom (W6ORG)
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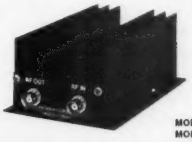

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CIRCLE 99 ON READER SERVICE CARD

• SUPERSCAF •

(A Switched-Capacitor Audio Filter)

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Nostalgia—
Philco To Hollywood

I sat glued to the dial. It had been years since I had tuned in to any of the world above the BC band. It was 1958, and there I was hearing voices from other countries . . . other nations . . . other places. Oh, I had heard them before many years ago when the old Philco console in our livingroom still had a semblence of life to it. The Philco had been a wedding gift to my Mom and Dad in the late '30s. It was state-of-the-art for its time: a dozen or so "loctal" tubes in the RF, IF, and audio preamp sections; a pair of 2A3s for audio output; and a Type 80 as the power rectifier.

That box really could blast you out of the room with 25 watts RMS into a 12" electrodynamic speaker. It also boasted the strangest record player ever designed—one that had the needle vibrating a mirror that modulated a beam of light going to a photocell. It only played 78 RPM records, but in that era that's all there was.

As a toddler I sat glued to the old Philco, listening to such programs as "Let's Pretend," "Big John and Sparkie," "The Lone Ranger," and of course "Little Orphan Annie." By age 5, I even had my very own Little Orphan Annie Secret Society Decoder Pin. To this day I can remember the vibrant tones of announcer Pierre Andre listing out the numbers that made up the "secret message" from Annie. For those born after WW II, I can only suggest that you rent a videocassette of "A Christmas Story" which was written and produced by my friend Jean Shepherd K2ORS. It tells it truly like it was.

Death of a Radio

Sometime in late 1950 or 1951, the Philco stopped playing. By the time it crackled its last, I was old enough to have discovered what the "other numbers" on its tuning dial were. By age 9, I had graduated from "Annie" to the "Beeb," and also to some other voices that spoke in tongues that I could not understand. In fact, I understood little of what was said on the BBC, but I listened intently because it sounded different.

About the time the Philco went to the place where good old radios go, my Dad went out and bought another toy. It was a strange object with a 10" glass window and was called an RCA Model 630 Television Set. Dad said it was a radio with pictures, and indeed it was. Soon, all of the characters I had learned to love in my imagination on the Philco were there in front of me on the RCA. Names like Big John Arthur, Andy Devine, The Lone Ranger, and Hoppalong Cassidy became living creatures in my kids' world, and the voices from the Philco soon faded into the ether. The Philco itself had become naught but a table to support the RCA "Looking Glass."

I had developed more than just an affinity for the technical side of radio and television. During my junior high years, I started hanging around a local radio store whose owner realized that I was not going to let him alone until he taught me everything he knew. His name was Sol Rosenthal, although we all called him Jommie. Thanks to Jommie, by the time I entered Lafayette High School in Brooklyn New York, I could completely field-strip and rebuild on-site any Victor, Bell & Howell, or Ampro sound projector that had been built to date.

I could troubleshoot any problem in a radio or television receiver and affect a cure. I had also gotten the Philco to play again, albeit poorly, and with quite a bit of hum. There was just no budget for a kid in his young teens to buy expensive electron tubes to replace those that had developed heater-to-cathode leakage. I lived with the hum, and that made shortwave reception impossible.

It was only a few days after starting high school that I met Henry Feinberg. To this day I can remember the odd lettering across his loose-leaf notebook. Just five characters: K2SSQ. I knew that was a ham radio callsign, so I surmised correctly that Henry was a radio amateur. In short order we had become friends; then close friends. It was on my second or third trip to Henry's house that he gave me an old Emerson table radio.

The Emerson looked like any other old radio except that it tuned two bands. It covered both the standard broadcast band plus shortwave from about 5 MHz on up to 18 MHz. It didn't work very well. But after a stop over at Jommie's shop and an hour session with the RCA Ryder Channelist and Clough-Brengle signal generator, we soon had the 1935 beastie percolating better than when it was new. Jommie was a true master at getting every microvolt of sensitivity out of a radio, and he walked me step-by-step through alignment procedures that were not in any book! By 7 PM that night, after Dad inspected the radio to make sure that I would not electrocute myself, I was busy tuning in the world. Little did I realize that moment was to shape my destiny and guide my life.

Graduation

Within a year, I graduated to a used Heathkit receiver. Another year and I obtained my ham license and built my first transmitter. Several years later I was among the first to introduce SSB to the VHF ham bands. With the advent of repeaters, I designed and installed the first split-split repeater to operate in a locality and in an era where most people felt that amateur radio and two-way FM had nothing in common.

Shortwave listening and ham radio led me to broadcasting as a career. I started in radio, did a stint in automated disco lighting, spent some time in consumer electronic service, and was playing with broadcast videotape recorders almost from the day that Ampex developed the VRX-1000. I've written and published several books and numerous magazine articles, and co-produced several films and videos. In "Amateur Radio's Newest Frontier," I got the chance of a lifetime and actually climbed aboard the spaceship Columbia. I again felt like a kid with a new toy—only a lot better!

Epilogue

Time passes. It's now almost Thanksgiving Day, 1987. Maybe that's why all this has been running through my head. After a while, one tires of repeaters, and repeater owners fighting the frequency coordinator, fighting a pirate repeater trying to take the channel, or fighting each other. I thought all that would have died by now, but with each wave of new hams, we get history repeating itself. Life goes on.

But, sadly, not forever. Jommie is gone. He was a good friend and a good teacher. Did I mention that he eventually became a ham and joined in on the fun with our old 6-meter gang? I was very sad to learn of his passing several years ago. I have a sneaky feeling, though, that he would be happy to know that the kid who hung around his store worked out.

Henry is still around. I've written about him before, and, in fact he has written a few articles for this magazine. While we were still in Lafayette High School, Henry got a part time job working with Don Herbert on Don's original "Watch Mr. Wizard" show. Talk about something that can change your life. Henry originally wanted to be an electronic engineer. Today he is the director of corporate exhibits for AT&T. He designed the Bell Telephone pavillion at Walt Disney World's Epcot Center in Florida, produced a number of award-winning films for the old Bell Telephone System, and just finished work on the brand new AT&T Corporate Exhibition Center in New York City. In amateur radio circles, I think he's probably best known as the ham who helped ET to call home. You may remember in the Spielberg classic "ET—The Extraterrestrial," the space communicator built from a party umbrella, Speak 'n Spell toy, and assorted electronic goodies. That "communicator" was designed and built by ham radio's own K2SSQ with parts purchased at the Dayton Hamvention Flea Market!

Have to run. Have to buzz-up Henry on the landline and get some information on how to fix the disk-drive for this Commodore C-64. One of them went belly-up a while ago, but even though he's 3,000 miles away, our friendship lasts the miles. What other hobby bridges the miles in less than a wink of an eye?

Oh yes, does anyone out there know what ever happened to some of my other high-school aged ham friends? Let's see: There was Vinnie Bonjourno WA2JYG; Bill Regina WA2PHR—and a special guy named Charlie Zusman WA2AKX. None of them are in the Callbook anymore. It's Charlie's fault that I became a ham in the first place. I must tell you that story sometime. The thoughts of yesterday race through my mind as I write the late shift from Los Angeles. 73

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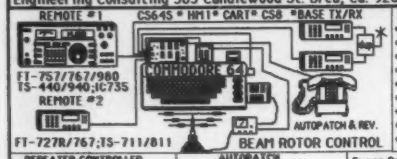

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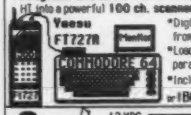

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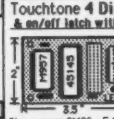

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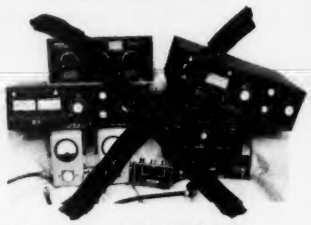

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Commodore Repairs. We are the largest Authorized Service Center in the country and we repair your Commodore computer within days. (Our prices are low; eg. C64–$39.95 complete)..."THE COMMODORE DIAGNOSTICIAN", an invaluable double sided laminated guide for fixing your C64/1541 drive. It diagnoses 72 variables and tells you what chips are faulty. $6.95 plus $1 postage... C-64 Power Supply $27.95 plus postage... VISA/MC... Call Toll Free 1-800-248-2983 (Nationwide) or 914-356-3131. Kasara Microsystems, Inc., 38 Murray Hill Drive, Spring Valley NY 10977. BNB587

Wanted: Lafayette PrivaCom 3C, 525, 625, or GE 5813B. RADIO, 2053 Mohave Dr., Dayton OH 45431. BNB589

MARCO: Medical Amateur Radio Council, operates daily and Sunday nets. Medically oriented amateurs (physicians, dentists, veterinarians, nurses, therapists, etc.) invited to join. For information, write MARCO, Box 73's, Acme, PA 15610. BNB612

Wanted. Drake R7A Receiver Tony Ficarra, 144 Gladstone Avenue, Wollongong, NSW, Australia 2500, Phone (042) 29 2573. BNB615.

DX Adventure on Monserrat only $300/week. Details: Chod Harris VP2ML Box 4881-7, Santa Rosa, CA 95402. BNB618

Wanted: Equipment and related items. THE RADIO CLUB OF JUNIOR HIGH SCHOOL 22 NYC, INC. is a nonprofit organization, granted 501(c)(3) status by the IRS, incorporated under the laws of the State of New York with the goal of using the theme of Ham Radio to further and enhance the education of young people. Your property donation would be greatly appreciated and acknowledged with a receipt for your tax deductible contribution. Please contact WB2JKJ using the callbook or telephone 516-674-4072, 24 hours, seven days a week. Thank you! BNB621

Superfast Morse Code Supereasy. Subliminal cassette. $10. LEARN MORSE CODE IN 1 HOUR. Amazing new supereasy technique. $10. Both $17. Moneyback guarantee. Free catalog: SASE. Bahr, Dept. 73-9, 2549 Temple, Palm Bay FL 32905. BNB624

Written Exams Supereasy. Memory aids from psychologist/engineer cut study time 50%. Novice, Tech, Gen: $5 each. Advanced, Extra: $10 each. Money back guarantee. Bahr, Dept 73-9, 2549 Temple, Palmbay FL 32905. BNB625

Homebrew Projects List. SASE WB2EUF, Box 708, East, Hampton, NY 11937. BNB626.

DEAD BATTERY PACK??? NiCads/Inserts/Rebuilding. Replacement inserts, less wires/plugs; ICOM BP2 $17.95, BP3(Std.) $16.95, BP5 $23.95, BP7 $29.95, Kenwood; TR2400 $19.95, TR2500/2600 $24.95, Tempo; S1/270mah $21.95, S1,2,4,5,15/450mah $22.95, Azden; 300 $19.95, Ten-Tec; 2991 $24.95, Santec; 142/1200 W/plug $21.95, For rebuilding; Add $3 and we install inserts in ICOM and Kenwood, (send your packs.) For others/info., SASE. In PA add 6%. Add $2 S&H/order. CUNARD ASSOCIATES, R.D. 6 Box 104, Bedford PA 15522. BNB628

Antenna Traps designed quickly and accurately with your computer. Send $10 for APPLE or IBM-PC program disk and manual, SASE for more information. W1HUE, 119-7 Buckland St., Plantsville CT 06479. BNB630

QSLs, QSLs, Rusprint QSLs, Quantities of 100, 200, 300 or more. Full color Old Glory and Cartoon. Also Parchment, Golden Eagle, and others. SASE appreciated. Rusprint, Rte 1, Box 363-73, Spring Hill KS 66083. BNB643

R-390A Receiver: $115, electronically complete, reparable (Government–removed meters, operation unaffected). R-390A parts: Info SASE. Professional/Miltary quality TS-352 Voltohm/Multimeter, AC-DC, with leads, manual: $12.50. Mint military-spec pull-out 12AT7, 6BA6, 6AG5, 6AL5: $10/six. CPRC-26 Infantry Manpack Radio, 6 meters FM, Receiver-Transmitter sections, cabinet, antenna, crystal, handset: $22.50 complete, $42.50/pair. H-251 Military Communications Headphones: $7.50. Add $4.50/piece shipping ($9 maximum), except R-390A shipped collect. Baytronics, Box 591, Sandusky OH 44870. BNB649

New Quick Charge"AA" NiCds Ten for $11.00 plus shipping. "AAA" NiCds just $1.65 each. "C" or "D" size NiCds just $3.00 each. Universal NiCd Charger just $9.99 Amphenol PL-259 Connectors just 80 cents each. R. Richard, 1787 Village Green Dr., Clairton PA 15025; 412-655-7494. BNB650

Amateur Radio Stamps for collectors. Israel $5. Luxembourg $1.50. Send SASE for complete list to Phil Sager WB4FDT, 126 Whiting Lane, West Hartford CT 06119. BNB651

HALLICRAFTERS HT-37 TRANSMITTER, clean, low hours, $150. Large Variac, 22 Amps, new, boxed, w/case, retails $296, sell $75. TEST EQUIPMENT: Tektronix scope, General Radio signal generators, DVM, many other items. Please SASE for list. Joseph Cohen, 200 Woodside, Winthrop MA 02152. 617-846-6312. BNB654

Kenwood TS940 Owners: Easy to install EPROM makes tuning in signals simple with an SSB/CW slow tuning rate of 2kHz. Faster turning gives faster tuning rate. $25 Giehl Electronics, PO Box 18335, Cincinnati OH 45218. BNB655

APPLE Owners Keep track of your DX contacts. This program files, sorts, alphabetizes and counts your DX contacts for each band. Need disk drive. $22. Scott Newpower, 673 Parkview Ave., St. Paul MN 55117. BNB657

TEN-TEC ARGONAUT WANTED State s/n, condition, accessories. Rod Sharp N5NM, Box 2169, Santa Fe NM 87504; 505-988-2305. BNB660

ATLAS 350-XL WANTED State s/n, condition, accessories. Rod Sharp N5NM, Box 2169, Santa Fe NM 87504; 505-988-2305. BNB661

Brownies QSLs since 1939. Catalog and samples $1. (refundable with order) 3035 Lehigh Street, Allentown PA 18103. BNB662

Barter 'N' Buy advertising must pertain to ham radio products or services.

☐ **Individual (noncommercial)** ..... **25¢ per word**

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Prepayment required. *Count only the words in the text. Your address is free. 73* cannot verify advertising claims and cannot be held responsible for claims made by the advertiser. Liability will be limited to making any necessary corrections in the next available issue. Please print clearly or type (double-spaced).

No discounts or commissions are available. Copy must be received in Peterborough by the fifth of the second month preceding the cover date. Make checks payable to *73* Magazine and send to: Hope Currier, **Barter 'N' Buy, *73* Magazine, WGE Center, Peterborough NH 03458.**

PROPAGATION

Jim Gray W1XU

EASTERN UNITED STATES TO: GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7A	14	14	14	14
ARGENTINA	21	14	14	7A	7	7	7A	14	14A	21A	21A	21
AUSTRALIA	21	14	7A	7B	7B	7B	7	7	7	7B	14	14A
CANAL ZONE	14	14	7A	7	7	7	7A	14	14	14	21	21
ENGLAND	14	7A	7	7	7	7A	14	14	14	14A	14A	14A
HAWAII	21	14	14A	7	7	7	7	7	14	14	14	21
INDIA	14	14	7B	7B	7B	7B	7A	14	14	14	14	14
JAPAN	14	14	14B	7B	7B	7B	7B	7B	14B	14	14	14
MEXICO	14	14	7A	7	7	7	7	14	14	14	14A	14
PHILIPPINES	14	14	14B	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14	14	7A	7	7	7	14	14	14	14	14A	14A
SOUTH AFRICA	7	7	7	7	7B	14	14	14	14A	14A	14	14
U. S. S. R.	7A	7	7	7	7	7B	14	14	14A	14A	14	14
WEST COAST	14A	14A	14	7	7	7	7	14	14	14	14A	14A
CENTRAL UNITED STATES TO:												
ALASKA	14	14	14	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	14A	14	7A	7	7	7A	14	14A	21A	21A	21
AUSTRALIA	21	14	7A	7B	7B	7B	7	7	7	7B	14	14A
CANAL ZONE	21	14	7A	7	7	7	7A	14	14	14A	21A	21
ENGLAND	14	7A	7	7	7	7	7A	14	14	14	14A	14
HAWAII	21	14	14A	7	7	7	7	7	14	14	14	21
INDIA	14	14	7A	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	7B	7B	7B	7B	7B	14B	14	14	14
MEXICO	14	14	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14A	14A
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	14	14A	14	14
U. S. S. R.	7A	7	7	7	7	7B	14B	14	14A	14	14	14
WESTERN UNITED STATES TO:												
ALASKA	14	14	7A	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14A	14	14	7	7	7	14	21	21A	21A	21
AUSTRALIA	21A	14A	14	14	7A	7A	7	7	7	7B	14	21
CANAL ZONE	21	14	7A	7	7	7	7A	14	14	14	21A	21
ENGLAND	14	7A	7	7	7	7	7B	7A	14	14	14	14
HAWAII	21A	14A	14	14	7A	7	7	7	14	14	21	21
INDIA	14	14	14	7A	7B	7B	7B	7A	14	14	14	14
JAPAN	14A	14A	14	14	14B	7B	7B	7B	14B	14	14	14
MEXICO	14	14	7A	7	7	7	7	14	14	14	14A	14A
PHILIPPINES	14A	14	14	14	14B	7B	7B	14B	14	14	14	14
PUERTO RICO	14A	14	7A	7	7	7	7	14	14	14	14A	14A
SOUTH AFRICA	7	7	7	7	7B	7B	7B	14	14	14A	14	14
U. S. S. R.	7B	7B	7	7	7	7	7B	14B	14	14	14	14
EAST COAST	14A	14A	14	7	7	7	7	14	14	14	14A	14A

A = Next higher frequency may also be useful.
B = Difficult circuit this period.
First letter = night waves. Second = day waves.
G = Good, F = Fair, P = Poor. * = Chance of solar flares.
@ = Chance of aurora.
NOTE THAT NIGHT WAVE LETTER NOW COMES FIRST.

Propagation Forecast—February 1988

Propagation conditions for February will generally be good. Seasonal increases in the MUF will bring increased DX activity on the higher bands—expect 10, 12, and 15 meters to be open until early evening hours on many days of the month. Twenty meters will be open until well after dark. There will be some days, however, when the earth's magnetic field will be unsettled to active, rising to storm levels on a few days. Look for poor propagation on the 6th–8th, 17th–19th, and 24th–26th of the month. The remaining days should be good to fair. Monitor WWV to spot the trends in the Ap and K indexes, and be alerted to changes. The *higher* the A and K indexes, the *worse* the conditions of the HF bands. Atmospheric noise will still be low, so expect excellent propagation on 40, 80 and 160 meters after local dark. February is the prelude to March and April when spring—for the first time in many years—will bring really HOT DX and MUFs often above 30 MHz and even to 50 MHz!

FEBRUARY

SUN	MON	TUE	WED	THU	FRI	SAT
	1 F–G	2 G	3 G	4 G–F	5 F	6 F–P
7 P	8 P–F	9 F	10 F–G	11 G	12 G	13 G–F
14 G–F	15 G–F	16 F	17 F	18 F–P	19 P–F	20 F–G
21 G	22 G–F	23 F	24 P	25 P	26 P–F	27 F
28 F–G	29 G					

BARTER 'N' BUY

from page 59

"Hamlog" Computer Programs 17 modules. Full features. auto-logs, 7-band WAS/DXXCC. Apple $19.95. IBM, Kaypro, Tandy, C-128 $24.95. KA1AWH, PB 2015, Peabody MA 01960. BNB666

SMART BATTERY CHARGER for GELL CELLS or LEAD ACID BATTERIES. It controls the bulk current, tapers and limits the overcharge voltage, after which it dutifully maintains the battery float level. Can be connected to the battery INDEFINITELY, will not overcharge! Great for boat, motorcycle, dune-buggy, RV, burglar alarm or other applications where the battery is not used for a long period of time. Standard kit is 12V at 500ma. For 6V, 14V or 24V add $1 and specify voltage. Complete kit, nothing else to buy, only $49.95, plus $3.50 shipping. Order #150 Kit. A & A Engineering, 2521 W. LaPalma Ave. #K, Anaheim CA 92801. 714-952-2114. BNB668

2.4 kHz AM Demodulator with 8 bit A-D and buffer Copy WEFAX from GOES SATELLITES or APT from NOAA POLAR ORBITING SATELLITES. Created for use with Elmer Schwittek's Multifax 2.0 program, available through him. Order #206-Kit $49.95 or assembled and tested board Order #206-ASY $69.95. Add $2.50 shipping per order. A & A Engineering, 2521 W. LaPalma, Unit K, Anaheim CA 92801. 714-952-2114. BNB669

I Pay Cash for new and used vacuum tubes, especially vintage and transmitting types. I also buy vintage audio equipment by Western Electric, Altec, McIntosh, Marantz, Westrex, etc. Randy Nachtrieb WA6GJA, 6392 Park Ave., Garden Grove CA 92645; 714-897-9351. BNB671

K1BV DX Awards Directory complete rules for over 680 certificates, 170 pages. $14 postpaid. Ted Melinosky, 525 Foster Street, South Windsor CT 06074-2936. BNB672

Customized Buttons: Name and Call or Picture on button or Keychain $3.50 each P.P. N8GXZ, 303 W. Marshall Road, McDonald OH 44437. BNB674

QSLs And RUBBER STAMPS TOP QUALITY! States, World Maps, USA, Key, Shuttle, Globe QSLs. Report Form Rubber Stamps. More! Samples $1 (Refundable with Order). Ebbert Graphics D-7, Box 70, Westerville OH 43081. BNB675

Soldering Station and Tools European and American. Free catalog. Robert W. Mink Import-Export, Box 6437S, Fair Haven NJ 07704. 201-758-8388. BNB682

UNSUAL OPPORTUNITY Small electro-magnetic mfg. company in rural west central New Jersey (15 employees) is looking for genial workaholic with driving desire to learn all aspects of business, including design, testing and inventing. Degrees not required nor necessarily advantageous. Mature persons in good health gladly considered. Potential limited only by ability and ambition. Send resume to Magnetics and Controls, Inc., P.O. Box 127, Rosemont NJ 08556. BNB685

1988 PRODUCT & PRICE LIST of our KITS & ASSEMBLIES is now available. Send SASE to: A & A Engineering, 2521 W. LaPalma, Unit K, Anaheim CA 92801. BNB686

XEROX 800 Electronic Typing System technical Information or schematics needed. Terry Thompson, Box 935, Dania FL 33004-0935; 305-920-1909. BNB687

Used Radio, TV and electronics books. SASE for list. LASH, 19 E. 157th Street, So. Holland IL 60473. BNB688

CODE PROGRAMS. Apple/C-64-128. 37 Modes, Graphics, Lessons, Wrdprcsr, Menus. LARESCO, POB 2018-ST, Calumet City IL 60409. 312-891-3279. BNB689

EASY CODE By the Old Master, 90 min. Learning tape $7. 60 min. Practice tapes $6 each, any speed. Specify. Add $1 S & H. Write: The Old Master, Box 29013, Atlanta GA 30359-0013. BNB690

20' RADIO TOWER (25-G) with 5'antenna. Retails $925. Must sell $425. Scott H. Henley, 5105 N. Lake Drive, Lake City GA 30260. 404-363-2356. BNB691

Wanted: Power Supply for Collins KWM-1 or connecting cable and PTO. Ken Moore KA7WDV, 11120 S.W. Blakeney, Beaverton OR 97005. BNB692

CALLSIGN/NAME BADGES. Snazzy and Unique. SASE FOR PRICE LIST. BADGES. P.O.B. 637, Louisburg KS 66053. BNB693

PARTS, PARTS, PARTS, Quality Components for the Home-Brew Radio Amateur. Two F.C. Stamps for Catalog. Small Parts Center, 6818 Meese Drive, Lansing MI 48911. BNB694

Manuals for test equipment. 1000's in stock. Write for availability and price. JBM, 7061 Hagvenhurst #207B, Van Nuys CA 91406. BNB695

INDIVIDUAL PHOTOFACT FOLDERS #1 to #1400, $3. #1401 up, $5. Sams Books, $6. Postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow NY 11554. BNB696

NEW! CB Radios & Scanners

Communications Electronics,™ the world's largest distributor of radio scanners, introduces new models of CB & marine radios and scanners.

NEW! Regency® TS2-RA

Allow 30-90 days for delivery after receipt of order due to the high demand for this product.

List price $499.95/**CE price $339.95**
12-Band, 75 Channel • Crystalless • AC/DC
Frequency range: 29-54, 118-175, 406-512, 806-950 MHz.
The *Regency* TS2 scanner lets you monitor Military, Space Satellites, Government, Railroad, Justice Department, State Department, Fish & Game, Immigration, Marine, Police and Fire Departments, Aeronautical AM band, Paramedics, Amateur Radio, plus thousands of other radio frequencies most scanners can't pick up. The *Regency* TS2 features new 40 channel per second *Turbo Scan*™ so you wont miss any of the action. Model **TS1-RA** is a 35 channel version of this radio without the 800 MHz. band and costs only $239.95.

Regency® Z60-RA

List price $299.95/**CE price $148.95/SPECIAL**
8-Band, 60 Channel • No-crystal scanner
Bands: 30-50, 88-108, 118-136, 144-174, 440-512 MHz.
The *Regency* Z60 covers all the public service bands plus aircraft and FM music for a total of eight bands. The Z60 also features an alarm clock and priority control as well as AC/DC operation. Order today.

Regency® Z45-RA

List price $259.95/**CE price $139.95/SPECIAL**
7-Band, 45 Channel • No-crystal scanner
Bands: 30-50, 118-136, 144-174, 440-512 MHz.
The *Regency* Z45 is very similar to the Z60 model listed above however it does not have the commercial FM broadcast band. The Z45, now at a special price from Communications Electronics.

Regency® RH256B-RA

List price $799.95/**CE price $329.95/SPECIAL**
16 Channel • 25 Watt Transceiver • Priority
The *Regency* RH256B is a sixteen-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to 16 frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH256 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A *60 Watt* VHF 150-162 MHz. version called the **RH606B-RA** is available for $459.95. A UHF 15 watt, 10 channel version of this radio called the **RU150B-RA** is also available and covers 450-482 MHz. but the cost is $439.95.

Bearcat® 50XL-RA

List price $199.95/**CE price $114.95/SPECIAL**
10-Band, 10 Channel • Handheld scanner
Bands: 29.7-54, 136-174, 406-512 MHz.
The *Uniden Bearcat* 50XL is an economical, handheld scanner with 10 channels covering ten frequency bands. It features a keyboard lock switch to prevent accidental entry and more. Also order the new double-long life rechargeable battery pack part # **BP55** for $29.95, a plug-in wall charger, part # **AD100** for $14.95, a carrying case part # **VC001** for $14.95 and also order optional cigarette lighter cable part # **PS001** for $14.95.

PC 22

NEW! Scanner Frequency Listings

The new Fox scanner frequency directories will help you find all the action your scanner can listen to. These new listings include police, fire, ambulances & rescue squads, local government, private police agencies, hospitals, emergency medical channels, news media, forestry radio service, railroads, weather stations, radio common carriers, AT&T mobile telephone, utility companies, general mobile radio service, marine radio service, taxi cab companies, tow truck companies, trucking companies, business repeaters, business radio (simplex) federal government, funeral directors, veterinarians, buses, aircraft, space satellites, amateur radio, broadcasters and more. Fox frequency listings feature call letter cross reference as well as alphabetical listing by licensee name, police codes and signals. All Fox directories are $14.95 each plus $3.00 shipping. State of Alaska–**RL019-1**; Baltimore, MD/Washington, DC–**RL024-1**; Chicago, IL–**RL014-1**; Cleveland, OH–**RL017-1**; Columbus, OH–**RL003-2**; Dallas/Ft. Worth, TX–**RL013-1**; Denver/Colorado Springs, CO–**RL027-1**; Detroit, MI/ Windsor, ON–**RL008-2**; Fort Wayne, IN /Lima, OH– **RL001-1**; Houston, TX–**RL023-1**; Indianapolis, IN–**RL022-1**; Kansas City, MO/ KS–**RL011-2**; Los Angeles, CA–**RL016-1**; Louisville/Lexington, KY–**RL007-1**; Milwaukee, WI/Waukegan, IL–**RL021-1**; Minneapolis/St. Paul, MN–**RL010-2**; Nevada/E. Central CA–**RL028-1**; Oklahoma City/Lawton, OK–**RL005-2**; Pittsburgh, PA/Wheeling, WV–**RL029-1**; Rochester/ Syracuse, NY–**RL020-1**; Tampa/St. Petersburg, FL–**RL004-2**; Toledo, OH–**RL002-3**. A regional directory which covers police, fire ambulance & rescue squads, local government, forestry, marine radio, mobile phone, aircraft and NOAA weather is available for $19.95 each. **RD001-1** covers AL, AR, FL, GA, LA, MS, NC, PR, SC, TN & VI. For an area not shown above call Fox at 800-543-7892 or in Ohio 800-621-2513.

Regency® Informant™ Scanners

Frequency coverage: 35-54, 136-174 406-512 MHz.
The new *Regency* Informant scanners cover virtually all the standard police, fire, emergency and weather frequencies. These special scanners are preprogrammed by state in the units memory. Just pick a state and a category. The Informant does the rest. All Informant radios have a feature called *Turbo Scan*™ to scan up to 40 channels per second. The **INF1-RA** is ideal for truckers and is only $249.95. The new **INF2-RA** is a deluxe model and has ham radio, a weather alert and other exciting features built in for only $324.95. For base station use, the **INF5-RA** is only $199.95 and for those who can afford the best, the **INF3-RA** at $249.95, is a state-of-the-art, receiver that spells out what service you're listining to such as Military, Airphone, Paging, State Police, Coast Guard or Press.

Regency® HX1500-RA

List price $369.95/**CE price $218.95**
11-Band, 55 Channel • Handheld/Portable Search • Lockout • Priority • Bank Select Sidelit liquid crystal display • EAROM Memory Direct Channel Access Feature • Scan delay
Bands: 29-54, 118-136, 144-174, 406-420, 440-512 MHz.
The new handheld *Regency* HX1500 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 55 channels at the same time including the AM aircraft band. The LCD display is even sidelit for night use. Includes belt clip, flexible antenna and earphone. Operates on 8 1.2 Volt rechargeable Ni-cad batteries (not included). Be sure to order batteries and battery charger from the accessory list in this ad.

Bearcat® 100XL-RA

List price $349.95/**CE price $178.95/SPECIAL**
9-Band, 16 Channel • Priority • Scan Delay Search • Limit • Hold • Lockout • AC/DC
Frequency range: 30-50, 118-174, 406-512 MHz
Included in our low CE price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. Order your scanner now.

★★★ *Uniden CB Radios* ★★★

The *Uniden* line of Citizens Band Radio transceivers is styled to compliment other mobile audio equipment. Uniden CB radios are so reliable that they have a two year limited warranty. From the feature packed PRO 540e to the 310e handheld, there is no better Citizens Band radio of the market today.

PRO310E-RA *Uniden* 40 Ch. Portable/Mobile CB . . . $85.95
NINJA-RA PRO310E with rechargeable battery pack.$99.95
B-10-RA 1.2V AA Ni-cad batt. for Ninja (set of 10) $20.95
PRO520E-RA *Uniden* 40 channel CB Mobile $59.95
PRO540E-RA *Uniden* 40 channel CB Mobile $119.95
PRO710E-RA *Uniden*40 channel CB Base $119.95
PC22-RA *Uniden* remote mount CB Mobile $99.95
PC55-RA *Uniden*mobile mount CB transceiver. $59.95

★★★ *Uniden Marine Radios* ★★★

Now the finest marine electronics are available through CEI. The *Unimetrics* **SH66-RA** has 50 transmit and 60 receive frequencies with 25 or 1 watt power output. Only $169.95. The *Unimetrics* **SH 88-RA** is a deluxe full function marine radiotelephone featuring 55 transmit and 90 receive channels and scanning capability for only $259.95. The *Unimetrics* **SH3000-RA** is an excellent digital depth sounder, good for 300 feet. It has an LCD continuously backlit with red light display and a 5 ft. or 10 ft. alarm. Only $189.95. Order today.

Bearcat® 800XLT-RA

List price $499.95/**CE price $289.95/SPECIAL**
12-Band, 40 Channel • No-crystal scanner Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512, 806-912 MHz.
The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½."

OTHER RADIOS AND ACCESSORIES

Panasonic RF-2600-RA Shortwave receiver $179.95
RD55-RA *Uniden* Visor mount Radar Detector $98.95
RD9-RA *Uniden* "Passport" size Radar Detector . . . $169.95
***NEW!* BC70XLT-RA** *Bearcat* 20 channel scanner . . . $168.95
BC 140-RA *Bearcat* 10 channel scanner $92.95
BC 145XL-RA *Bearcat* 16 channel scanner. $98.95
BC 175XL-RA *Bearcat* 16 channel scanner $156.95
BC 210XLT-RA *Bearcat* 40 channel scanner. $196.95
BC-WA-RA *Bearcat* Weather Alert™ $35.95
R1080-RA *Regency* 30 channel scanner $118.95
R1090-RA *Regency* 45 channel scanner $148.95
UC102-RA *Regency* VHF 2 ch. 1 Watt transceiver . . . $117.95
P1412-RA *Regency* 12 amp reg. power supply . . . $189.95
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B-4-RA 1.2 V AAA Ni-Cad batteries (set of four) $9.95
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FB-E-RA Frequency Directory for Eastern U.S.A. $14.95
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SRF-RA Survival Radio Frequency Directory. $14.95
TSG-RA "Top Secret" Registry of U.S. Govt. Freq. . . . $14.95
TIC-RA Techniques for Intercepting Comm. $14.95
RRF-RA Railroad frequency directory. $14.95
EEC-RA Embassy & Espionage Communications . . . $14.95
CIE-RA Covert Intelligenct, Elect. Eavesdropping . . . $14.95
MFF-RA Midwest Federal Frequency directory $14.95
A60-RA Magnet mount mobile scanner antenna. . . . $35.95
A70-RA Base station scanner antenna. $35.95
MA548-RA Mirror mount Informant antenna. $39.95
USAMM-RA Mag mount VHF ant. w/ 12' cable. $39.95
USAK-RA ¾" hole mount VHF ant. w/ 17' cable. . . . $35.95
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Add $7.00 shipping per radio and $3.00 per antenna.

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CIRCLE 121 ON READER SERVICE CARD

SPECIAL EVENTS

Ham Doings Across the Country

Special Events listings will be provided by 73 Magazine free of charge on a space-available basis. Announcements must be received by us by the first of the month, two months prior to the month in which the event takes place (by March 1, for example, for a May or later event). Please mail to Editorial Offices, 73 Magazine, WGE Center, Peterborough NH 03458. ATTN: Special Events

PUNXSUTAWNEY PA
JAN 31

Special Event Station WA3LVU will commemorate Groundhog Day on January 31, 1988. Starting time is 1400Z and operation will be on 20 and 40 meter phone band. Certificate for SASE to *Doug Hunter WA3LVU, Rockland Ave., Punxsutawney PA 15767.*

VERNON WINTER CARNIVAL
FEB 5–14

NORAC's special event station will again commemorate western Canada's largest winter carnival, the Vernon Winter Carnival. This special event station will operate daily during the carnival which will be held on February 5th to the 14th, 1988. Our operating frequency will be 14.235, with possible operation on all other bands depending on conditions. Any station contacting our club station "VE7NOR" will qualify for a commemorative certificate. To receive the certificate qualifiers are asked to send their QSL info and 2 IRC's or $1 to *NORAC, Box 1706, Vernon BC, V1T 8C3 CANADA.*

ST. CATHARINES ONTARIO
FEB 6

The Niagara Peninsula Amateur Radio Club Inc., is holding the 10th Annual Big Event, celebrating the 40th anniversary of the club with a Hamfest and dinner dance on February 6th at the C.A.W. Hall, 125 Bunting Road, St. Catharines Ontario. Admission $3, Tables $12 commercial and $5 non-commercial. Talk-in 147.24/84. For further information please write *N.P.A.R. Inc., P.O. Box 692, St. Catharines Ontario, L2R 6Y3 CANADA; or phone 416/937-0590.*

DEARBORN MI
FEB 7

The Livonia Amateur Radio Club will hold its 18th annual LARC Swap 'n' Shop on Sunday February 7th, from 8:00 AM to 4:00 PM, at Dearborn Civic Center in Dearborn, Michigan. ARRL/VEC amateur radio examinations will be given by the Motor City Radio Club. Plenty of tables, door prizes, refreshments and free parking. Talk-in on 144.75/5.35 and .52. Reserved table space of 8-foot minimum available. For further information, send SASE (4x9) to *Neil Coffin WA8GWL, c/o The Livonia Amateur Radio Club, P.O. Box 2111, Livonia MI 48151.*

DECATUR IL
FEB 12–13

The Cenois Amateur Radio Club will operate K9HGX from 1400Z to 0200Z on February 12th and 13th in honor of Abraham Lincoln's birthday. Suggested frequencies: 3.875, 7.250, 14.250 and 21.325 kHz on phone-3.725 and 7.125 kHz on Novice bands. For certificate, send QSL and large SASE to *K9HGX, Box 4595, Decatur IL 62521.*

NEWBURGH NY
FEB 13

The Orange County ARC will operate WB2SON February 13, 1500Z-2200Z, from Washington's Headquarters, to commemorate George Washington's birthday. Suggested frequencies: 3.860, 7.230, 14.260. Also, local 2-meter repeaters and packet will be active for contacts. For certificate, send QSL and 9 x 12 inch SASE (39 cents) to *OCARC, c/o Barbara Christopher N2AWI, RFD 2 Box 447, Wallkill NY 12589.*

TRAVERSE CITY MI
FEB 13

The Cherryland Amateur Radio Club, announces its Fifteenth Annual Swap 'N Shop to be held on Saturday, 13 February at the Immaculate Conception Middle School gymnasium, 218 Vine Street, Traverse City, Michigan, from 8:00 AM through 1:30 PM. Admission is $3; tables $5. Talk-in on 146.85 repeater. For information, contact *Mick Glasser N8DBK, 4102 Peninsular Shores Dr., Grawn MI 49637; 616/276-9203.*

MANSFIELD OH
FEB 14

The Mansfield Mid-Winter Hamfest/Computer Show will be held Sunday February 14, at the Richland County Fairgrounds. There will be prizes, forums and a flea market in large, modern, heated buildings. Doors open to the public at 7:00 AM. Forums include DX, Packet, ARES, and more. Tickets $3 in advance and $4 at the door. Tables $5 in advance and $6 at the door. Half tables available. Talk-in, call W8WE on 146.34/94. Advanced ticket/table orders must be received and paid by Feb. 4. For additional information or advanced tickets/tables send SASE to *Dean Wrasse KB8MG, 1049 Beal Road, Mansfield OH 44905; 419/589-2415 after 4 PM EST.*

MARLBORO MA
FEB 14

The Algonquin ARC is sponsoring the Electronics Flea Market at 10:00 AM to 2:00 PM, on February 14. Sellers are to arrive at 8:00 AM at Marlboro Middle School Cafeteria, Union Street off Route 85. Talk-in on 146.01/61 and 146.52. Admission is $2. Tables are $8 in advance, $10 at the door. Wheelchair accessible. For more information contact *Dan KB1WW at 617/481-1587 or write A.A.R.C., Box 258, Marlboro MA 01752.*

MELVILLE NY
FEB 14

The Long Island Mobile Amateur Radio Club, Inc., is holding its LIMARC Hamfest on Sunday, February 14, in the Electricians Hall, 41 Pinelawn Road, Melville Long Island. Doors open at 9 to 3. Admission is $4 and $3 after 11:30 AM. Sellers 4' x 6' tables are $12 or bring your own at $1.50 a foot, 6 foot minimum, helpers pay admission. Registration in advance only, check payable to LIMARC. L.I.E. Route 495 to Exit 49 N, ¼ mile right turn onto Pinelawn Road. Talk-in on 146.85. For more information contact *Hank Wener WB2ALW, 53 Sherrard St. East Hills NY 11577; 516/484-4322. Or Mark Nadel NK2T at 516/ 976-2366.*

LOVELAND CO
FEB 14–15

The Loveland Repeater Association will sponsor a special events station in conjunction with the Loveland Valentines activities. Operation will be up 25 kHz from the lower edge of the General class phone bands and up 25 kHz from the lower edge of the Novice 10 meter band. 1300 UTC–0700 UTC February 14th and 15th. Send SASE for QSL to *KA0VFF, Michael H. Walker, 3816 Ash Ave., Loveland CO 80538.*

POLK COUNTY
FEB 20

The Salem and Oregon Coast Emergency Repeater Associations will sponsor the 1988 Ham Fair on Saturday, February 20th beginning at 9:00 AM at the Polk County Fairgrounds. Admission is $4 in advance or $5 at the door. Activities include ARRL/VEC testing, giant flea market, exhibits, and commercial dealers. Talk-in on 146.26/.86. For more information write: *Salem Repeater Assoc., P.O. Box 784, Salem OR 97308.*

HARLINGEN TX
FEB 20–21

The South Texas Amateur Repeater Society will be holding their STARfest on February 20 and 21 at 9 AM Saturday (set-up at 7 AM), runs through Sunday. It will be held at Casa de Amistad (Civic Center), Fair Park Blvd. (from north, exit US 77 at Fair Park Blvd. exit, east half mile; from west, exit expressway US 83 at Lewis Lane exit, east toward US 77-north, and east from jct. with US 77 half mile.) Talk-in: English language, 147.39; Spanish language, 146.70. Advance is $5 and at the gate is $6. Contact for flea market, reservations *Dr. David Woolweaver K5RAV, 2210 South Sunshine Strip, Harlingen TX 78550; 512/425-7744 or 425-3128.*

SARASOTA FL
FEB 20–21

S.A.R.A., Inc., will be holding its 9th Annual Hamfest and Computer Show on February 20 and 21 at the Robarts Sports Arena, 300 Ringling Boulevard. There will be Forums, exams, Saturday Night Banquet, a QCWA Luncheon and prizes. Tables are $16, advance tickets are $5 and banquet tickets are $15. RV hookups are $10 a night. For more information contact *Al Matlick at S.A.R.A Inc., Sarasota Hamfest, Inc., 1817 Buccaneer Terrace, Sarasota FL 33581.*

HERNANDO COUNTY FL
FEB 27

The Hernando County Amateur Radio Association is sponsoring its sixth Annual Hamfest on Saturday February 27th at the Hernando County Fairgrounds Auditorium. Doors open at 8 AM and exams start at 9:30 AM. Preregistration is preferred. Advance registration is $2, at the door is $3, and the swap tables are $8. Free overnight parking is permitted. For more information contact *Regis Kramer W41LE, 900-2032 US 41 North, Brooksville FL 34601; 904/796-6802*.

DALTON GA
FEB 27

Dalton Amateur Radio Club will be holding its annual Hamfest at the North GA, Fairgrounds on Saturday, February 27 at 9 AM til 3 PM. License exams will be offered at the Western Sizzler Family Steak House. W.C.A.R.S. will be the VEC and advance reservations are encouraged. Mail reservations for exams to club *P.O. Box N4OTC at 404/673-2291 or K4FLG at 404/278-0630*.

HAMEL MN
FEB 27

The Robbinsdale Amateur Radio Club is sponsoring the 7th annual Midwinter Madness Hobby Electronics Show on February 27, 1988 at 8 AM. There will be a large indoor flea market, retail exhibits and FCC testing. The show will be held at Medina Ballroom, on highway 55, 4 miles west of I-494, in Hamel MN. Admission is $3 in advance and $4 at the door. Tables are $8 and half tables are $4. Talk-in on 147.60/00 K0LTC Repeater, 146.52 Simplex. To register send a SASE and Fees to: Robbinsdale ARC, P.O. Box 22613, Robbinsdale MN 55422. For FCC Exam Registration: Send completed Form 610, photocopies of Current License and Code Credit and $4.55 (Payable to ARRL/VEC) to: Ron Schultz, 6308 Peacedale Ave., Edina MN 55424.

DAVENPORT IA
FEB 28

The Davenport Radio Amateur Club will host its annual Hamfest Sunday, February 28 from 8 AM to 3 PM at the Davenport Masonic Temple. The event will feature a large indoor flea market, walk-in VE testing, food and prizes. For flea market tables and advance tickets: *Davenport Radio Amateur Club, 2131 Myrtle, Davenport IA 52804*.

LAPORTE IN
FEB 28

The Laporte ARC's Winter Hamfest is Sunday, February 28 at the Laporte Civic Auditorium. Laporte is 50 miles southeast of Chicago. Talk-in on 146.01/.61 and 146.52 simplex. Forum will include the Midwest Microwave Society's Construction exhibit and seminar (bring your SHF projects). Donation is $3. Table charge is also $3 and may be reserved in advance by SASE. *LPARC, P.O. Box 30, Laporte IN 46350*.

CUYAHOGA FALLS OH
FEB 28

The Cuyahoga Falls Amateur Radio Club's 34th annual Hamfest will be held at the Akron North High School from 8 AM to 3PM on Sunday, February 28. Tickets are $3 in advance and $4 at the door. Tables are $5, half tables available. Sellers may bring their own tables. Tables will be $6 at the door, if we have any left. SASE for ticket orders and table reservations, please. Plenty of room for buyers and sellers–over 32,000 sq. ft. Easy access from Tallmadge Ave., off ramp of North Expressway (Rte. 8). Talk-in on 87/27. Route 8 connects to all major expressways and Ohio turnpike. Details from *Bill Sovinsky K8JSL, 2305 24th St., Cuyahoga Falls OH 44223; 216/923-3830*.

LAND OF LEGEND CONTEST
FEB 27–28

Land of Legend Contest, is sponsored by the Newark Amateur Radio Association, from 1600Z February 27 until 2359Z February 28. Phone only. Certificate for working ten N.A.R.A. members, five for DX, during contest period. DX is other than W, K, N, or A. Exchange signal report, name, and QTH. Suggested frequencies: 80M 3.860 ±, 40M 7.235 ±, 20M 14.250 ±, 15M 21.335 ± and 10M 28.450 ±. Business size SASE and logs to *Newark Amateur Radio Association Contest, P.O. Box 149, Newark OH 43055*. Deadline for submission is March 31, 1988. For further information contact *Rick Crane KA8RBQ, 174 North Gay Street Newark OH 43055. Or Don Kinney KA8MAQ, 2843 Mount Vernon Rd., Newark OH 43055*.

CIRCUITS

Number 26 on your Feedback card

Great Ideas From Our Readers

Many readers will recognize the revival of this regular feature, which has been absent from the pages of *73* for several years. We welcome brief contributions of circuits. If your idea is published, you will receive a free subscription or a renewal. Clearly indicate that your submission is for this column and not a manuscript for an article.—Ed.

C-64 POWER SUPPLY

Having problems with your Commodore power supply? If so, Figure 1 will help you. When my power supply failed I opened the unit (some are sealed), traced wiring, and drew the schematic. The 3052 regulator was defective and I replaced it with the readily-available 7805. NOTE: The pin out is different. There are two types of supplies—those that have failed and those that are going to; so save this drawing.

–George Taylor WA4GUW
Muscle Shoals AL

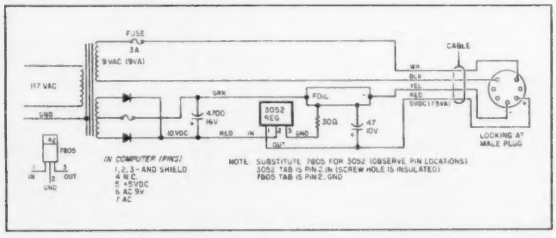

Figure 1. Power supply schematic for Commodore 64.

VARIABLE C-MOS OSCILLATOR

The oscillator section made up of the inverters (U1) is a typical oscillator configuration. The unique feature is the ability to alter the frequency of oscillation digitally. U2 is a CMOS transfer gate, which is used to parallel additional resistors (R2 and R3) with R1. The transfer gate U2 has four separate switch sections. Two switch sections are paralleled to provide a low-enough "on" resistance when a resistor is selected. The off resistance is high enough to prevent U2 or R2 and R3 from loading the oscillator when only R1 is selected. If a TTL interface is required, the unused sections of U1 may be paralleled to provide a single TTL load. The oscillation frequency can be approximated by F= ½.2RC. This formula will provide a "ball-park" value for the resistor and capacitor values. The value of C1 shown in the schematic is typical.

–Nick Hulbert KG5N
Colorado Springs CO

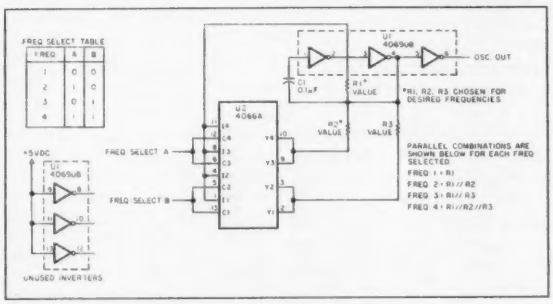

Figure 2. Variable CMOS oscillator. The U2 transfer gate switches additional resistors in and out, varying the circuit's frequency.

WEATHERSATS

View On Video Processing

Dr. Ralph E. Taggart WB8DQT
602 S. Jefferson
Mason MI 48854

Purely Digital

Last month I spent quite a bit of time looking at a range of enhancement options using "transparent digital" techniques. This month I will finish up discussion of image processing with some information on purely digital techniques, usually implemented using a computer. All of these techniques are based on manipulating the numerical value of pixel data. This is a fascinating subject I only can barely introduce in the space available this month. For those who want to pursue the subject in greater depth, most university and larger public libraries will have texts on digital processing techniques. One useful and inexpensive one ($14.95) is Digital Image Processing by Gregory A. Baxes, published by Prentice-Hall, Inc. of Englewood Cliffs, NJ 07632. Most bookstores will special-order a copy, or contact the publisher directly.

Computer-assisted digital processing can be used in a number of ways, depending upon the nature of the system. It can be incorporated into an outboard image processor of the type described last month. In this case the techniques apply to any display system since the processing occurs prior to image display. The user can also incorporate the techniques into a computer-assisted scan converter by processing the image data between the A/D conversion and the storage of image data in memory. This is most suitable for systems where memory storage is limited. Finally, users can store linear data in the image memory and perform any processing when passing data from memory to the actual display part of the system.

The first two approaches are simple, but since any processing is performed "on the fly," any change in processing routines requires reloading the test image from tape. The third option requires a lot of RAM but allows multiple processing routines from a store of image data in RAM without having to reload the image with each trial.

Evaluating the Image

Although trial and error can work, it's best to have some information about the distribution of brightness values in the image. The most useful approach is to write a program to construct a graph or histogram of the distribution of various pixel brightness values in the picture.

As one example, a BASIC program could look at the contents of the video memory where the picture resides. If the memory contains 6-bit video values, then an array with 64 entries (0–63) is required, one for each possible pixel value. Stepping through the video memory is possible, PEEKing at the value of each pixel and updating the appropriate array entry by one. In the end the operator can step through the array and prepare a plot showing the number of pixels of each brightness value in the image. The major limitation with this approach is the time required to examinine a large video memory using BASIC. Analysis of only a few lines of video will save time. An assembly language subroutine can evaluate large blocks of memory very quickly and then revert back to BASIC to actually plot the data.

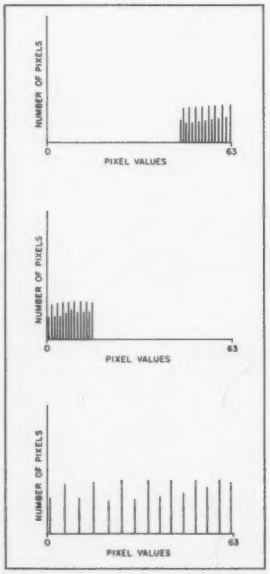

Fig. 1. Diagrammatic examples of pixel histograms showing data from:
(a) an IR line of NOAA APT data.
(b) the line after the "pixel slide". The purpose of a "slide" is to shift the entire cluster of pixels down the histogram so that the smallest pixel values will be zero.
(c) The line after multiplying each pixel value in 1B by 4. There is now a full range of contrast, with pixel values between 0 and 60.

Figure 1A shows a diagrammatic example of such a pixel histogram of hypothetical data obtained from an IR line of NOAA APT data. Note that all pixels are near the white end of the dynamic range. For the sake of argument, suppose they all fall in the range of 48 to 63. The aim is to expand the contrast of this data, which requires a two-step processing sequence.

The Pixel Slide

The process must first set the "blackest" pixel value, in this case a decidedly light 48, to true black or 0. This requires one of the most fundamental digital processing steps—the "pixel slide." A "slide" will shift the entire cluster of pixels down the histogram so the smallest pixel values will be zero. In the simplest case, with the data in Figure 1A simply subtract 48 from each pixel in memory and store the result back in place of the original value. The result is a distribution similar to Figure 1B. The picture remains low contrast, but the lowest pixel value is 0!

Practically speaking, pixel values less than the desired threshold will complicate real-world data. If this were real APT IR data, most of the pixels would be clustered as Figure 1A indicates. There would, however, always be pixels between 0 and 48 because of grayscale steps, minute markers, etc. Since the system probably doesn't like negative values for pixels, a real world slide would actually involve two possibilities for each pixel in memory:

1. If the original pixel value is below 48, set the new value to 0; or
2. if the value is greater than 48, subtract 48 from the original value and store the remainder.

Most visible data in the video line with the IR and all the miscellaneous ones noted earlier will be converted to 0. The slide of the IR data is then complete.

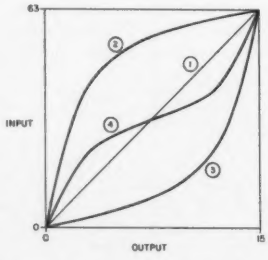

Fig. 2. A sample of four conversion curves that can be used to achieve a variety of effects. See text for details on what each curve means.

Contrast Expansion

The video data in Figure 1B now consists of pixels in the range of 0 to 15. To generate a full range of contrast, multiply each pixel value in Figure 1B by 4. Figure 1C shows the resulting frequency distribution. This is a full range of contrast with pixel values between 0 and 60. A display of the new data will show a picture of excellent contrast.

Note, however, there only 16 discrete pixel values ranging from 0 to 60 in steps of 4. This underscores the need to always digitize the original data to significantly more resolution than actually needed for display. The original image contained 16 usable steps in the 48–63 range. There's no way to generate additional steps, even by expanding the contrast! If the original data had been 4-bit, the best expansion would have good contrast, but only 4 grayscale steps!

Visible Data

Although the above procedure would work for expanding IR contrast, what are the techniques for visible data? The steps may differ slightly, but the principle is the same. Consider a visible light distribution with pixels in the range of 0–15 with only IR data or miscellaneous minute marker/grayscale data in the 16–63 range. In this case a slide is not required, since the darkest pixels in the visible light data are already 0. First convert any pixels between 16 and 63 to 15, then carry out the expansion step.

How to expand some specific mid-range value? Simply clip all pixels below the lowest desired threshold to that value. Similarly, convert all pixels above the highest threshold to the high threshold value. Then perform a slide to set the low threshold to 0, followed by an expansion.

All of the previous discussion assumes the user changes the values in the main memory, but this isn't the only approach. If a lot of memory is available, the altered video data can pass to a buffer

memory or the display memory if that is separate from the main video buffer.

The operator can also perform the same conversions on the fly if desired. He'll need to run the tape through the evaluation program to get the initial pixel distribution, but once he knows what needs to be done, each pixel can be modified individually on a second run. In fact, although the previous discussion treated the slide and expansion as distinct steps, the user can perform both on each pixel with a single series of operations. In the case of the first IR example, the sequence might look like this:

1. Check the pixel. If less than 48, set it to 0 or,

2. if greater than 48, subtract 48 to perform the slide.

3. Multiply each pixel by 4 for the expansion

Nonlinear Processing

Everything discussed this month and last has involved clipping and expansion of video data. Clipping means throwing out data that falls outside of the range of interest and working with the rest. I did this last month by setting the A/D thresholds, while this month I did the same thing with our mathematical manipulations.

Many real world processing problems are more complex. For example, how to improve contrast of, say, the IR segment of a line without completely losing the visible light data? Alternatively, how does the user expand the contrast at the black end of the visible range in a visible light image, to improve the definition of land/water features, for example, without the complete loss of bright cloud detail? This is very difficult to do with analog circuits and is quite complex with last month's "transparent digital" approach. It is quite easy however with purely digital techniques.

Figure 2 shows a sample of four conversion curves used to achieve a variety of effects. Although the example illustrates the conversion of 6-bit data to 4-bit format, the process works between any combination of input and output format. Curve 1 is included for reference only since it represents a linear conversion in that the brightness characteristics of the output track those at the input. The remaining curves are quite different, however. Curve 2 represents a logarithmic expansion of the white part of the grayscale. The black data is not lost, it just occupies a smaller number of output steps than the original. The majority of the output steps are devoted to the white end of the dynamic range. Curve 3 is complimentary in that it performs a log black expansion. In this case, most of the output steps are devoted to the black end of the dynamic range with compression of the white data. Finally, Curve 4 is a mid-range expansion with compression of the extreme black and white ends of the dynamic range.

VALUE	COLOR
15	white
14	light cyan
13	light magenta
12	light blue
11	yellow
10	light green
9	light red
8	light gray
7	dark gray
6	dark cyan
5	dark magenta
4	dark blue
3	orange
2	dark green
1	dark red
0	black

Table 1. Grayscale-to-color conversions for a 4-bit display system that assigns bit 0 to red, bit 1 to green, bit 2 to blue, and bit 3 to intensity.

Expansions of this type are best achieved using lookup tables, since the math can get fairly complex. With 6-bit input data, the table would have 64 entries (0–63) with each entry representing the desired output value. Each processing curve would need a table, and the prepared graph would determine the output value required for each input value. The lookup table could be an array in BASIC (slow!), or the table would be in memory, in the case of an assembly language routine. In the latter instance, address the start of the table, offset by the input pixel value, and then read the value from memory. Assembly language lookup tables are more than fast enough for on-the-fly processing, and they are also a convenient way to pass data from the video memory to a display.

Although all of the discussion to this point emphasizes contrast expansion, there are lots of additional possibilities. Any number of oddball curves can be constructed to meet specific needs to highlight, emphasize, or recognize certain features in an image. There are also unlimited options for false-color displays, if the display allows that option. Depending on the number of colors available, a lookup table is a simple way to convert any brightness value to any color value. This gives absolute control over how the picture is displayed. This can be quite convenient, because it avoids the limitations on color values and sequencing inherent to dependence on a fixed assignment of data lines. For example, if a 4-bit display system assigns bit 0 to red, bit 1 to green, bit 2 to blue, and bit 3 to intensity, the various grayscale values will always translate to the colors listed in Table 1.

An image with a normal grayscale displayed in color would produce an absolutely chaotic range of colors very difficult to interpret and extremely difficult to view in the long run. A color lookup table would allow conversion of these values to any other value to achieve the desired correspondence between that grayscale step and the displayed color. IR data, for example, could be "rearranged" to provide a color spectrum that would be more easily interpreted in color terms (blues at the cold end, and reds, oranges, yellows, and white at the hot end). The user could also use a simpler color set, approximate water features in blue, land features in greens and browns, etc. This is not possible with any fixed arrangement of data lines, but it is easy to do with a lookup table, regardless of how the data lines are arranged!

"An image with a normal grayscale displayed in color would produce an absolutely chaotic range of colors."

The user's needs will determine the features incorporated into the processing system. For one thing, additional video routines and table do take up more memory, but usually the real memory usage occurs in the form of additional screen memories for all the new menus. Additional video options will also take up time, and that may be critical in on-the-fly applications.

If the basic A/D conversion takes up most of the available time, there will be a limitation in the number of modes the system can accommodate. If timing is a problem, try writing customized on-the-fly programs, each one incorporating one specific kind of processing option. Things are usually much simpler in the case of operating out of a large video memory and simply passing the data to the display in various ways. All data are treated in a linear fashion when the A/D data are passed to memory, and the processing function simply consists of different options in passing the data from memory to the display.

Well, that is an introduction to the world of image processing. No matter what kind of display system used, there are many ways to enhance the quality or utility of the images. Future columns may look again at specific projects, particularly for outboard processors, if there is an interest in the subject. 73

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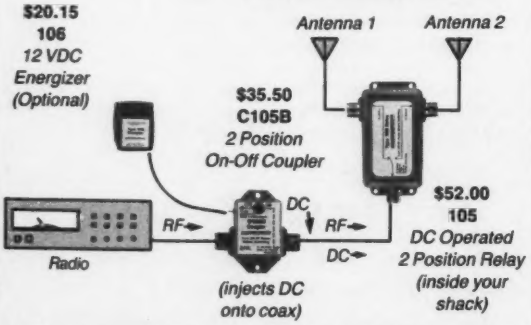

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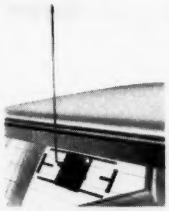

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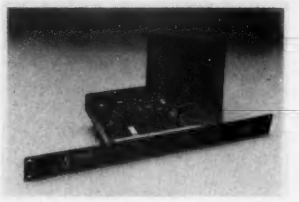

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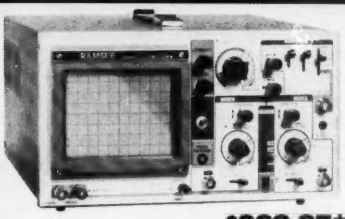

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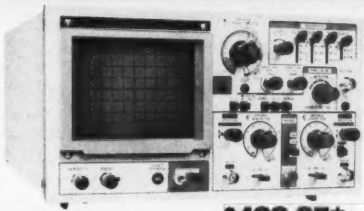

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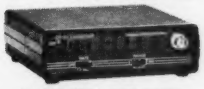

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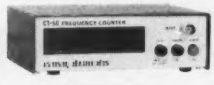

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CT-70	20 Hz-550 MHz	< 50mv To 150 MHz	1 PPM	7	1Hz, 10Hz, 100Hz	139.95
CT-90	10 Hz-600 MHz	< 10mv To 150 MHz < 150mv To 600 MHz	1 PPM	9	0.1Hz, 1Hz, 10Hz	169.95
CT-50	5 Hz-600 MHz	LESS THAN 25 mv	1 PPM	8	1Hz, 10Hz	189.95
CT-125	10 Hz-1.25 GHz	< 25mv @ 50 MHz < 15mv @ 500 MHz < 100 mv @ 800 MHz	1 PPM	9	0.1Hz, 1Hz, 10Hz	189.95
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AMSAT GENERAL MEETING

Space Symposium 1987

Beautiful, warm, sun-shiny Detroit, Michigan, was the site for the AMSAT NA General Meeting, Awards Banquet and Fifth Annual Space Symposium. Actually, I can't tell you much about the weather, since it was much easier to stay inside for the many fine presentations and thought-provoking discussions. Attendance was up from last year for this November gathering. Satellite enthusiasts from around the world converged on the Southfield Hilton, just north of Windsor, Canada. The Southeastern Michigan AMSAT members with Larry K8MU, convention chairman, put together an excellent weekend of activities.

This was the first year for a second, parallel, session of talks aimed at the non-ham with interests in space studies. For most hamsat chasers, the choices were easy. They went to the amateur radio sessions. For those with varied interests, the choices were sometimes impossible.

I had no difficulty deciding between an introduction to amateur radio, and Ray W2RS with his talk on low-power EME (Earth-Moon-Earth) operation. A few other choices were also easy, but when the competing talks included "Fast Scan Television Proposal for the Space Shuttle" by Andy N9AB and "Ham Radio from the Space Shuttle and the Space Station" by Dr. Tony England WCEN/0ORE, I found myself darting back and forth between the two rooms trying to catch the high points of both.

AMSAT President Vern Riportella WA2LQQ gave a fascinating presentation on techniques for determining satellite visual observation windows. In the other forum, previous AMSAT President Dr. Tom Clark W3IWI talked on digital versus analog signal-processing techniques. More decisions.

The choices went on all day Saturday, and even Sunday morning, when three presentations were in competition with the AMSAT NA Board of Directors Meeting. Even with so many tough selections, the symposium was a great success.

Some talks described activities via our current satellites.

Craig Underwood, from the University of Surrey in England, recounted classroom applications of satellites in the UK. Most of his presentation covered telemetry reception and decoding activities using UoSAT-OSCAR-9 and UoSAT-OSCAR-11. Mori JK1VXJ presented a paper on the FUJI-OSCAR-12 mailbox system. His co-authors included JR1ING and JR1FIG.

On the technical side, topics like "Digital Signal Processing Modems" and "Spread Spectrum Ranging and Non-Linear Filtering for Orbit Determination" prevailed. While the subjects may seem difficult, this was not the case thanks to the speaking skills of Dr. Bob McGwier N4HY.

A Look Ahead

Looking to the future, two goals for AMSAT NA came through loud and clear. After the launch of Phase 3C this spring, AMSAT will make a strong commitment to launch a packet radio satellite in the next few years. Launch opportunities to LEO (Low Earth Orbit) may soon become available. A packet satellite can cut down the drawbacks usually associated with an orbit between 300 and 1000 miles, like short view times and a limited horizon. With a polar orbit and a mailbox system for message storage, the inconvenience of non-real-time communications is overshadowed by system simplicity and less expensive ground station requirements compared with a high-orbit or geostationary satellite set-up.

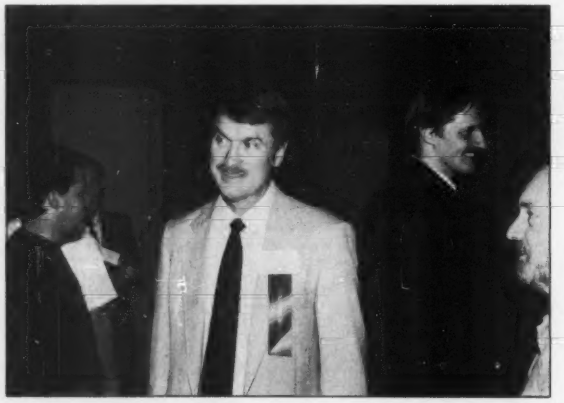
For the 1990s, we can look forward to Phase 4. AMSAT Vice-President for Engineering, Jan King W3GEY, and designer Dick Jansson WD4FAB gave the Phase 4 status report. They were also co-authors of another presentation on the attitude control system for this new family of long-life, geostationary hamsats. The technical challenges of the Phase 4 program are formidable compared to previous amateur spacecraft, and the expense will be more than 15 times greater than Phase 3C. After listening to the reports, discussions and arguments, Phase 4 still looks like the best program to pursue. Aim high.

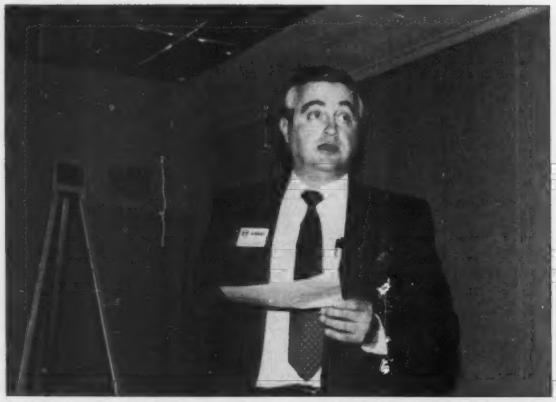
There were many other fine talks and presentations. Two stand out due to their potential application to future amateur satellite programs. The first was entitled "NUSAT: A Student Satellite Project of Weber State College" by William Clapp, and the second was "70,000 Feet over Ohio, An Amateur Radio Balloon Experiment" by Bill Brown WB8ELK.

The NUSAT program (Northern Utah Satellite) began in 1982. The purpose was to build a satellite to test the possibility of evaluating Federal Aviation Administration air traffic control beacon antennas using low-earth-orbit satellites. NUSAT-1 was launched in the Spring of 1985. Although it lasted only a little over a year-and-a-half, its mission was significant to the amateur radio satellite community. It was the first satellite to be launched from a Space Shuttle Get-Away-Special canister (GASCAN).

Future hamsats may depend on the simple launcher mechanism designed by Weber State College students for NUSAT-1 and may even be constructed using a frame similar to that proposed for the larger NUSAT-2.

Bill Brown's talk and video presentation of his FSATV (Fast-Scan Amateur Television) experiments via weather balloon were excellent. Many ham radio groups around the world have used balloons to test transmitters, transponders and other experiments, but it is doubtful if any have generated and transmitted ATV this way. The equipment was simple, light- weight, used an omni-directional antenna (bent on take off), and Polaroid flat-pack lithium batteries for power. Bill's results may have significant impact on uses of ATV from the Space Shuttle and perhaps amateur satellites.





Photos A, B. Two of the notables at the AMSAT Symposium—Tony England WØORE (white jacket and tie), who operated amateur radio from the space shuttle; and AMSAT President Vern Riportella WA2LQQ.

```
10        REM  ************************************
20        REM  * PROGRAM NAME IS RS10LZM.BAS BY WASSIE *
30        REM  * VERSION 2.0              DECEMBER 9, 1987 *
40        REM  * CONVERSION FACTORS DERIVED FROM JARC- *
50        REM  * ART 1988 RAMSATS COLUMN, 73 MAGAZINE. *
60        REM  * LINES WITH PRECEDING 'REM' STATEMENTS *
70        REM  * LABELED 'VAX' SHOULD BE CHECKED FOR  *
80        REM  * INCOMPATIBILITY WITH OTHER VERSIONS   *
90        REM  * OF BASIC EVEN THOUGH THE PROGRAM IS  *
100       REM  * SIMPLIFIED FOR EASE OF TRANSLATION.  *
110       REM  ************************************
120       PRINT
130       PRINT"************************************"
140       PRINT"*  RS 10/11 TELEMETRY DECODE PROGRAM *"
150       PRINT"*     BY ANDY MACALLISTER   WASSIE   *"
160       PRINT"*   VERSION 2.0  DECEMBER 9, 1987   *"
170       PRINT"************************************"
180       PRINT
190       PRINT"RS 10/11 TELEMETRY FRAMES ARE COMPOSED"
200       PRINT"OF 16 FOUR CHARACTER BLOCKS WITH THE"
210       PRINT"SATELLITE IDENTIFIER, EITHER RS10 OR"
220       PRINT"RS11, PRECEDING AND FOLLOWING EACH"
230       PRINT"FRAME.  AFTER ANSWERING THE QUESTIONS"
240       PRINT"IDENTIFYING THE FRAME UNDER STUDY,"
250       PRINT"YOU WILL BE ASKED FOR THE TELEMETRY."
260       PRINT"EIGHT BLOCKS AT A TIME. AS AN EXAMPLE:"
270       PRINT"RS11,H8C0,JG10,MG45,NG45,IK00,IE0C,IG0C"
280       PRINT
290       INPUT"WHICH SATELLITE (10/11)";S$
300       INPUT"DOWNLINK BAND (U/V)";DB$
310       INPUT"ORBIT DATE (MM,DD,YY)  ";MO$,DA$,YR$
320       INPUT"ORBIT NUMBER           ";N
330       INPUT"FRAME IDENTIFIER FOR THIS ORBIT (A,B,C, ETC.)";F$
340       INPUT"TIME OF CAPTURE IN UTC (XXXX)";T1$
350       PRINT"FOR EVERY FIRST EIGHT BLOCKS OF TELEMETRY"
360       INPUT B1$,B2$,B3$,B4$,B5$,B6$,B7$,B8$
370       PRINT"FOR EVERY LAST EIGHT BLOCKS OF TELEMETRY"
380       INPUT C1$,C2$,C3$,C4$,C5$,C6$,C7$,C8$
390       PRINT
400       PRINT"TELEMETRY DECODED FOR RS";S$;" ON ";MO$;"-";DA$;"-";YR$
410       PRINT"ORBIT NUMBER =";N;F$
420       PRINT"TIME OF CAPTURE IS ";T1$;" UTC"
430       PRINT"DOWNLINK BAND IS ";DB$;" METERS"
440       PRINT
450       REM DATA CONVERSION ROUTINES
460       REM BLOCK 1
470       REM  VAX - LEFT$ COMMAND BELOW EXTRACTS LEFT 2 CHARACTERS OF B1$
480       B1$=LEFT$(B1$,2)
490       IF B1$="I0" OR B1$="S0" OR B1$="D0" THEN B1W$="00" ELSE B1W$="10"
500       REM  VAX - RIGHT$ COMMAND BELOW EXTRACTS RIGHT 2 CHARACTERS OF B1$
510       B1=VAL(RIGHT$(B1$,2))
520       B1W-B1/4
530       REM BLOCK 2
540       B2$=LEFT$(B2$,2)
550       IF B2$="I0" OR B2$="S0" OR B2$="D0" THEN B2W$="00" ELSE B2W$="10"
560       B2=VAL(RIGHT$(B2$,2))
570       B2W-B2/10
580       REM BLOCK 3
590       B3$=LEFT$(B3$,2)
600       IF B3$="I0" OR B3$="S0" OR B3$="D0" THEN B3W$="00" ELSE B3W$="01"
610       B3=VAL(RIGHT$(B3$,2))
620       B3W-B3/5
630       REM BLOCK 4
640       D4$=LEFT$(D4$,2)
650       IF D4$="I0" OR D4$="S0" OR D4$="D0" THEN D4W$="00" ELSE D4W$="01"
660       D4=VAL(RIGHT$(D4$,2))
670       D4W-D4/5
680       REM BLOCK 5
690       D5$=LEFT$(D5$,2)
700       IF D5$="I0" OR D5$="S0" OR D5$="D0" THEN D5W$="00" ELSE D5W$="01"
710       D5=VAL(RIGHT$(D5$,2))
720       D5W-D5/5
730       REM BLOCK 6
740       D6$=LEFT$(D6$,2)
750       IF D6$="I0" OR D6$="S0" OR D6$="D0" THEN D6W$="00" ELSE D6W$="01"
760       D6=VAL(RIGHT$(D6$,2))
770       D6W-D6/5
780       REM BLOCK 7
790       H7$=LEFT$(H7$,2)
800       IF H7$="I0" OR H7$="S0" OR H7$="D0" THEN H7W$="1" ELSE H7W$="0.3"
810       IF VAL(RIGHT$(H7$,2))=0 THEN H7W$="00" ELSE H7W$="01"
820       REM BLOCK 8
830       H8$=LEFT$(H8$,2)
840       IF H8$="I0" OR H8$="S0" OR H8$="D0" THEN H8W$="1" ELSE H8W$="0.3"
850       IF VAL(RIGHT$(H8$,2))=0 THEN H8W$="00" ELSE H8W$="01"
860       REM BLOCK 9
870       C1$=LEFT$(C1$,2)
880       IF C1$="A0" OR C1$="U0" OR C1$="E0" THEN C1W$="00" ELSE C1W$="01"
890       C1=VAL(RIGHT$(C1$,2))
900       C1W-C1/10
910       REM BLOCK 10
920       C2$=LEFT$(C2$,2)
930       IF C2$="A0" OR C2$="U0" OR C2$="E0" THEN C2W$="00" ELSE C2W$="01"
940       C2=VAL(RIGHT$(C2$,2))
950       C2W-C2/10
960       REM BLOCK 11
970       C3$=LEFT$(C3$,2)
980       IF C3$="A0" OR C3$="U0" OR C3$="E0" THEN C3W$="00" ELSE C3W$="01"
990       C3=VAL(RIGHT$(C3$,2))
1000      C3W-C3/10
1010      REM BLOCK 12
1020      C4$=LEFT$(C4$,2)
1030      IF C4$="A0" OR C4$="U0" OR C4$="E0" THEN C4W$="00" ELSE C4W$="01"
1040      C4=VAL(RIGHT$(C4$,2))
1050      C4W-C4/10
1060      REM BLOCK 13
1070      C5$=LEFT$(C5$,2)
1080      IF C5$="A0" OR C5$="U0" OR C5$="E0" THEN C5W$="00" ELSE C5W$="01"
1090      C5=VAL(RIGHT$(C5$,2))
1100      C5W-C5/5
1110      REM BLOCK 14
1120      C6$=LEFT$(C6$,2)
1130      IF C6$="A0" OR C6$="U0" OR C6$="E0" THEN C6W$="00" ELSE C6W$="01"
1140      C6=VAL(RIGHT$(C6$,2))
1150      C6W-C6/5
1160      REM BLOCK 15
1170      C7$=LEFT$(C7$,2)
1180      IF C7$="A0" OR C7$="U0" OR C7$="E0" THEN C7W$="00" ELSE C7W$="01"
1190      C7=VAL(RIGHT$(C7$,2))
1200      C7W-C7/5
1210      REM BLOCK 16
1220      C8$=LEFT$(C8$,2)
1230      IF C8$="A0" OR C8$="U0" OR C8$="E0" THEN C8W$="00" ELSE C8W$="01"
1240      C8=VAL(RIGHT$(C8$,2))
1250      C8W-C8/5
1260      PRINT
1270      PRINT"RS";S$;" ";B1$;" ";B2$;" ";B3$;" ";B4$
1280      PRINT"      ";B5$;" ";B6$;" ";B7$;" ";B8$
1290      PRINT"      ";C1$;" ";C2$;" ";C3$;" ";C4$
1300      PRINT"      ";C5$;" ";C6$;" ";C7$;" ";C8$;" ";F$;$9
1310      PRINT
1320      PRINT"Data sampling period is once every ";B1W$;" minutes."
1330      PRINT"20 dB transponder receiver attenuator is ";B2W$;"."
1340      PRINT"10 dB transponder receiver attenuator is ";B3W$;"."
1350      PRINT"1 Meter receiver is ";B4W$;"."
1360      PRINT"1 Meter receiver is ";B5W$;"."
1370      PRINT"Special service channel is ";D6W$;"."
1380      PRINT"10 Meter beacon transmitter power is ";H7W$;" Watt(s)."
1390      PRINT"2 Meter beacon transmitter power is ";H8W$;" Watt(s)."
1400      PRINT"First memory board is ";C1W$;"."
1410      PRINT"Second memory board is ";C2W$;"."
1420      PRINT"Special channel memory is ";C3W$;"."
1430      PRINT"Message store memory is ";C4W$;"."
1440      PRINT"Memory output is to ";C5W$;" Motors."
1450      PRINT"15 Meter BEACON receiver attenuator is ";C6W$;"."
1460      PRINT"2 Meter BEACON receiver attenuator is ";C7W$;"."
1470      PRINT"Special channel power output is ";C8W$;" Watt(s)."
1480      PRINT
1490      INPUT"HIT RETURN TO CONTINUE";Y$
1500      PRINT
1510      PRINT"Main (30 Vdc) power supply voltage is";B1W;"Vdc."
1520      PRINT"2 Meter transponder power output is";B2W;"Watt(s)."
1530      PRINT"10 Meter transponder power output is";B3W;"Watt(s)."
1540      PRINT"15 Meter receiver AGC voltage is";B4W;"Vdc."
1550      PRINT"2 Meter receiver AGC voltage is";B5W;"Vdc."
1560      PRINT"Special service channel voltage is";D6W;"Vdc."
1570      PRINT"10 Meter command mode is ";H7W$;"."
1580      PRINT"2 Meter command mode is ";H8W$;"."
1590      PRINT"10 Meter transmitter temperature is";C1W;"degrees C."
1600      PRINT"2 Meter transmitter temperature is";C2W;"degrees C."
1610      PRINT"Main (30 Vdc) power supply temperature is";C3W;"degrees C."
1620      PRINT"9 Vdc power supply temperature is";C4W;"degrees C."
1630      PRINT"Backup 9 Vdc power supply temperature is";C5W;"degrees C."
1640      PRINT"15 Meter BEACON receiver IF voltage is";C6W;"Vdc."
1650      PRINT"2 Meter BEACON receiver IF voltage is";C7W;"Vdc."
1660      PRINT"BEACON QSO counter indicator ";C8W$;" contacts."
1670      PRINT
1680      INPUT"WOULD YOU CARE FOR ANOTHER RUN (Y/N)";Z$
1690      IF Z$="Y" THEN GOTO 200 ELSE GOTO 9000
9000      END
```

Figure 1. RS-10/11 Telemetry Decoding Program.

Other Activities

What else happens at the yearly AMSAT gathering? This is not a ham convention with manufacturers, distributors and swapfest tables, nor is it a stuffy conference that puts attendees to sleep. It is more like a reunion where projects of the past year are discussed and plans for the future are presented and refined. Many of the participants only see each other once a year, at this meeting.

For those who wish, things get started on Friday night at the hospitality suite. This is also an opportunity to take care of registration and to visit with other satellite enthusiasts you may have met on the air. Opening remarks and the main program start at 8 AM Saturday morning. This is sometimes a bit early for those who got started on Friday.

Each presentation lasts between 45 minutes and an hour. Some include slide shows, films, videotape presentations or just a chalkboard and some fine oration. Breaks occur often, and coffee is usually provided. Lunch with the group is an option and is prepaid at the time of registration. Dress is casual.

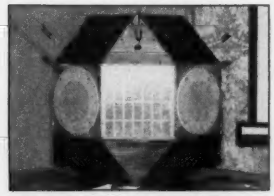


Photo C. Full-size model of the NUSAT-1, on display at the Symposium.

The Saturday night banquet is a must if you can attend. The keynote speaker in Detroit, Dr. Tony England, provided an excellent computer-generated animation of the proposed construction of the space station. The year before in Dallas, Dr. Martin Davidoff, author of the Satellite Experimenters Handbook, showed slides depicting the history of the amateur radio satellite program. Dress at the banquet is more formal than at the symposium.

The AMSAT meeting convenes after the banquet with a report on the health of the organization by the president. Awards are presented to those who have distinguished themselves with accomplishments on AMSAT's behalf. Finally the door prize tickets are drawn. In Detroit, the grand prize was an ICOM IC-475A 70cm transceiver.

Sunday continues with a few more technical sessions and the AMSAT Board of Directors meeting. This meeting is open. Sometimes a few topics are discussed privately, but the decision-making process of the corporation is open to members who care to attend. The board meeting may take a few days and put a few observers to sleep at times, but it is an important part of the organization.

Next year, we look forward to meeting in Atlanta, Georgia. Plan to attend. In the meantime, Phase 3C may be launched, new projects started, and a lot of great satellite chasing via our current group of operational hamsats will keep things going.

Telemetry Revisited

Last month I reported on RS-10/11 decoding. After doing conversions on many frames of data with a hand calculator and a chart, I decided to use a simple computer program to do the job.

The result is shown in Figure 1. It is written in VAX BASIC. I have tried to avoid using commands and routines that are peculiar to this version of BASIC, but some minor translating modifications will be required for most computers. The routines used are simple, with output directed only to the screen. Modifications for disk or printer output would be useful additions.

Pay close attention to those lines preceded by a REM-VAX comment. These lines will likely need conversion. I would be interested to hear from those of you with elegant versions of this telemetry program. Good computing! 73

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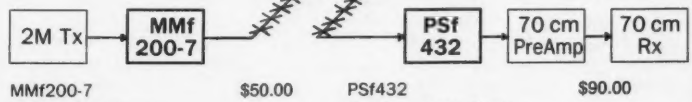

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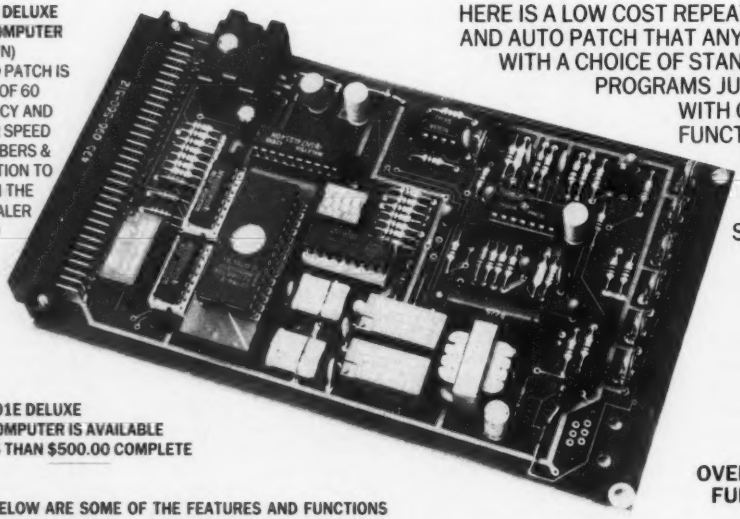

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#11 DIAL 9 FIRST, PBX FEATURE
#12 SEPARATE REVERSE AUTO PATCH ON/OFF COMMAND
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#22 ADJUSTABLE AUTO PATCH TIME OUT TIMER
#23 DTMF TONE MUTE AND COVER TONE MASKING
#24 REPEATER TIME OUT TIMER WARNINGS
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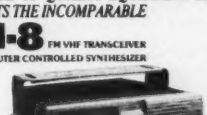

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"What's in it for me?" comes the cry from our faithful readers. Beside the knowledge that you're helping us find out what you like (and don't like), we'll draw one feedback card each month and award the lucky winner a free one-year subscription (or extension) to *73*.

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9	Winners	29	Ham Help
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Number 29 on your Feedback card

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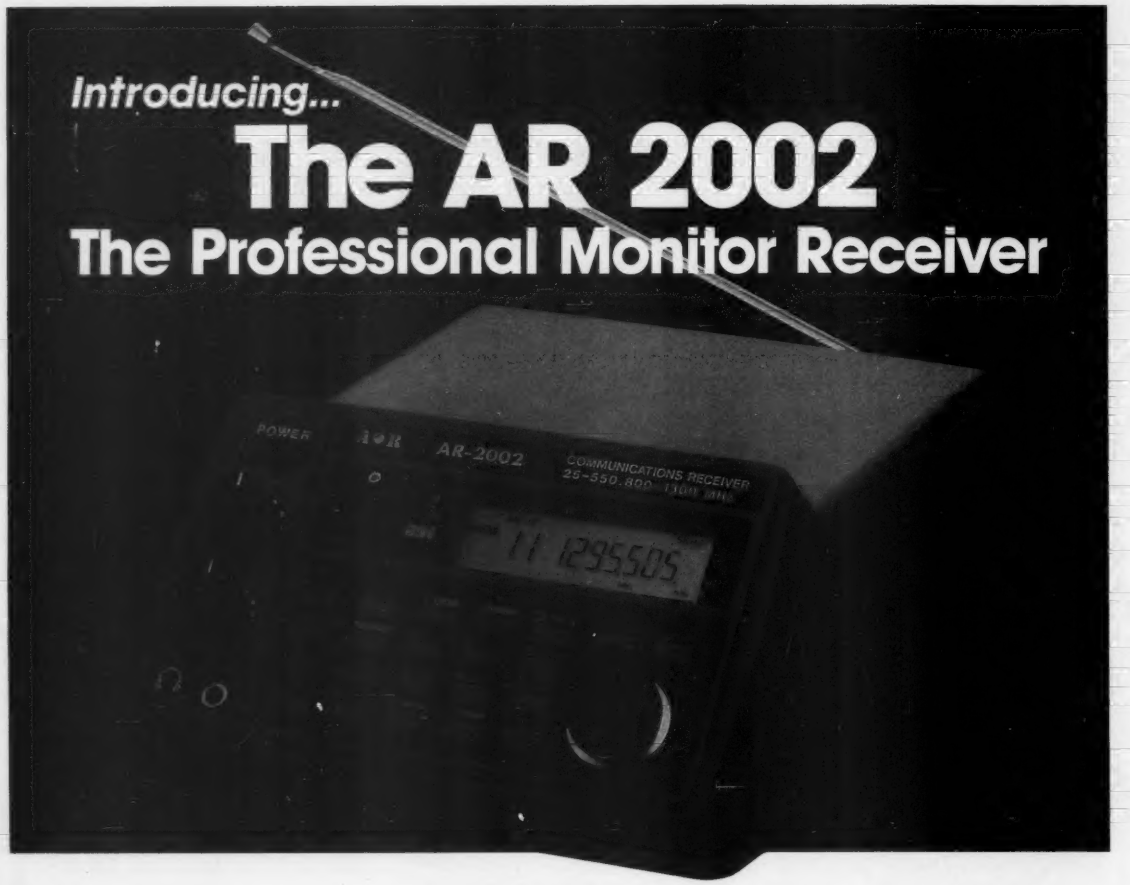

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PACKET TALK

Latest in Digital Hamming

Brian Lloyd WB6RQN
19200 Tilford Way
Germantown MD 20874

THE HEART OF PACKET

Happy Valentine's Day! This month I'm going back to the heart of packet radio with an examination of some of the current crop of narrow bandwidth FM (NBFM) radios that are in common use on packet. I'll also continue my discussion on improving packet radio's overall performance.

NBFM Transceiver Examination

Two months ago, I described techniques that allow you to get the most out of your TNC/radio combination. Many of the techniques described were there to correct for limitations inherent in the radios. As a result I decided to find out just how good or bad some of the current crop of radios really are.

Radios were tested for their transmitter and receiver audio frequency response characteristics. It seems that most of the NBFM radios these days conform to an equalization curve consisting of a 6-dB/octave pre-emphasis starting at about 300 Hz for the transmitter and a complementary 6-dB/octave roll-off for the receiver. Although this is different from the 75 microsecond standard, it seems to be consistent. In order to determine the relative performance, I compared the equalization curves for the receivers and transmitters to the "standard." Table 1 shows the difference between the "ideal" curve and the measured curves for the radios.

The receiver audio response curves were measured at the speaker with a known 3-kHz deviation signal generated by a calibrated signal generator. The transmitter curves were measured by injecting a signal at a fixed level that produced 3 kHz deviation at 2200 Hz (what we want for packet) into the microphone jack and the deviation measured on a Cushman service monitor. The deviation observed at 300 Hz was considered to be the 0-dB point for the relative measurements.

I was quite surprised! I expected completely horrible results in all areas. All of the radios seemed to be pretty flat in the critical 1200 to 3000 Hz range (and this after people had been telling me about how badly Kenwood radios roll-off the high frequencies). Both the Yaesu and the IC-275A had surprisingly flat receive curves. As a result I solved one packeteer's problem by bypassing the filter in the front end of his TNC's modem when it was connected to his IC-275A.

The Yaesu FT-211RH seems to have the best combined receive and transmit performance. The ICOM IC-275A is a wonderful radio for packet use if you can flatten out the transmitter response curve. I have found that many packet stations can't copy packets transmitted by the IC-275A. Clearly its transmit EQ curve needs work. I expected ICOM to get it perfect in a $1400 radio that is supposedly designed with packet radio in mind.

I want to thank the folk at EEB in Vienna, Virginia, and especially Ted Seely AA4GM for providing me with the radios, space, and test equipment to perform these tests.

How Fast Does Your Radio Switch?

When you first set up your station you probably adopted one of the more haphazard methods of setting TXDelay for your radio. One method is to use the value given to you by your friend. Another is to set it to some large value that has to work. Here's a procedure to let you find out what the value should be for your particular radio.

The equipment needed for testing is a pair of working packet stations. Be sure that you have set up your stations properly and that they work well together. (Use the techniques I outlined in the December column.)

To find the transmitter key-up time, follow these steps:

1. Leave the squelch on the receiving TNC wide open. This will allow the receiving TNC to recognize an incoming packet as quickly as possible.
2. Turn on monitor mode for the receiving TNC.
3. Set TXDELAY on the transmitting TNC to some arbitrary low value (50ms is just fine).
4. Send packets with the transmitting TNC without first establishing a connection. After each couple of packets you send, switch back to command mode and increase TXDELAY. Keep doing this until packets are received reliably at the receiving station. At this point you now know the minimum value of TXDELAY for the trasmitting station. Go back and perform this procedure for the other station.

Now you want to find out what the squelch delay is for each of the radios. The technique is the same as outlined above but just close the squelch of the receiving radio and continue with the transmissions while increasing TXDELAY at the transmitting station. The difference in the two values of TXDELAY (squelch open and squelch closed) is the squelch opening time for the receiver.

You should perform these tests for every packet station in your area so that the performance of each radio can be determined. That way you can set your TXDelay appropriately for all the stations in the area.

Some radios have a very long receiver recovery time. This means that after transmitting a packet it takes the radio a relatively long time before it is ready to receive packets again. If you find that you copy packets reliably when monitoring the channel and others seem to copy your packets reliably, but that you still can't make a connection, this is probably your problem. There is nothing that you can do to solve this problem at your station short of making major modifications inside the radio. All you can do is to get the other stations in your area to increase their TXDelay to accommodate your slow recovery time.

Making Your LAN Work Better

It is important to make sure your modem and radio work well together. This greatly improves the reliability of your packet operations. Having your own station work properly, however, is not sufficient to ensure reliable delivery of packets, because your station alone can't solve the most serious problem that your local area network (LAN) faces: the hidden terminal.

Simply stated, a hidden terminal is a station that shares the frequency with you but cannot hear or be heard by you. In all probability your packets are going to collide with those from the "hidden" station. The result is reduced throughput and longer delays, all because you cannot hear and therefore not wait for the other station to finish transmitting. Nor will he wait for you. In serious cases you will be able to hear the digipeater repeating packets, but it will not seem to hear you. In this case the signal from the hidden terminal or terminals is stronger than yours and they capture the receiver in the digipeater (I had this happen to me recently and I spent 15 minutes assuring myself that my station was not at fault).

There is a way to solve this problem: install duplex rather

Receiver Performance (error in dB)

Radio	300Hz	600Hz	1200Hz	1800Hz	2400Hz	3000Hz
ICOM IC-28H	0	8	13	13	11	8
Kenwood TM-221A	0	8	10	10	10	8
Yaesu FT-211RH	0	2	3	2	0	–2
ICOM IC-275A	0	3	3	2	1	0

Transmitter Performance (error in db)

Radio	300Hz	600Hz	1200Hz	1800Hz	2400Hz	3000Hz
ICOM IC-28H	0	0	0	–1	–1	–3
Kenwood TM-221A	0	0	2	2	2	2
Yaesu FT-211RH	0	3	4	2	3	1
ICOM IC-275A	0	4	14	12	13	12

Table 1.

than simplex digipeaters. You have used duplex digipeaters before but then you called them repeaters. The difference between a duplex digipeater and a repeater is that a repeater responds to an RF carrier and will repeat any signal in its passband. A duplex digipeater will only repeat digital signals and will not respond to voice. The recent changes to FCC Part 97 allow you to treat a duplex digipeater like a digipeater rather than a repeater (you do not have to operate a duplex digipeater under the repeater rules).

The real key to a duplex digipeater is that it repeats the signal in real time. That is, it retransmits the data at the same time it is receiving it. The result is that everyone who is listening to the output is aware of any activity on the input and will wait for the activity to cease before transmitting. There will be no hidden terminals because, in effect, all stations will hear all other stations. There is also the added benefit that there is no digipeater delay. This immediately doubles the amount of traffic that may be passed through the digipeater.

The major complaint about duplex digipeaters is cost. I usually hear people say something like, "...I can put up many more simplex digipeaters for the cost of one duplex digipeater. Won't I be able to support more users with several simplex digipeaters?" The answer is no. Several simplex digipeaters are NOT as efficient as a duplex digipeater. The cost is not that much greater for a duplex digipeater and the throughput is MUCH greater.

Let's examine the costs. Many items are common to both a simplex and a duplex digipeater. The common items are listed first, followed by the unique items:

Common Items:

Antenna	$100
Feedline	100
Power supply	75
Miscellaneous	50
Total:	$325

For a simplex digipeater:

Radio	$350
TNC	130
Total:	$480

For a duplex digipeater:

Receiver and enclosure	$275
Transmitter and enc.	275
Duplexer	470
Control circuitry	100
Total:	$1110

Based on these assumptions the cost for a simplex digipeater is $805 while the cost for a duplex digipeater is $1445. Based on this estimation, a duplex digipeater costs less than two simplex digipeaters.

Which One?

Which approach, however, supports the greatest number of users and moves the most traffic? Since the duplex digipeater never has any digipeater delay it automatically nets you a throughput improvement of 100%. Right there the cost-per-bit-per-second is less for the duplex digipeater.

Now we should consider things in terms of the type of network represented by the two approaches. A network based on the simplex digipeater most closely resembles ALOHA, which means that you don't bother listening, you just transmit whenever you want to. The duplex digipeater is best modeled by Carrier Sense Multiple Access (CSMA), which means you can hear everybody else, so you wait until a station has finished sending before you begin to transmit.

When there are many users on the channel ALOHA has a best-case throughput of 18%. CSMA (of the 1-persistant variety used in most of our TNCs) has a best case throughput of about 54%. Right there you have a three-fold improvement of the duplex digipeater over the simplex digipeater. Combine that with the lack of a digipeater delay, and you net at least a six-fold improvement in capacity with a duplex digipeater during busy times. So, a duplex digi gives up to six times the improvement for less than twice the cost of its simplex brother. With the advent of p-persistant CSMA (offered standard on the Kantronics and AEA TNCs and on the TNC-1s and TNC-2s with the KISS firmware—see the sidebar) you do even better than that.

The Practical Side

What does it take to build a duplex digipeater? Far less than what's required for a voice repeater! Since here we deal with essentially pure tones and can regenerate the tones at the repeater site, the control and processing circuitry is very simple. I just recently completed the construction of a duplex digipeater. Its control circuitry consists of a surplus Bell 202 modem, two transistors, an op-amp, and a handful of resistors and capacitors. No squelch is used with this setup, since the modem does a superb job of detecting the presence of packets. No tail timer is provided so the transmitter drops just as soon as the modem detects that the signal is gone. A very simple time-out timer is also provided. The ID is provided by a TNC sending a beacon on the input frequency.

How well does it work? Quite well. I ran a test the other night to see how much data would get through on a heavily loaded LAN. To perform this test I had three stations engage in file transfers simultaneously. Even with header overhead and the occasional collision, throughput was 93 bytes/second. On a 1200 bps channel this represents a throughput of almost 64% of channel capacity. This is considerably better than a simplex digipeater. When we tried it with a simplex digipeater the test failed. We could not even keep the connections established.

If you are looking for a reliable and efficient way to create a LAN where everyone can communicate effectively, this is a good solution. The only real alternative is to operate simplex without digipeaters and to make sure that everyone can hear everyone else—a viable alternative for a small town but not very practical for a large area such as a county or a large city.

Some time in the not-too-distant future I will see to it that the design for the duplex digipeater control circuitry appears either as an article or here in this column.

That's it for another month. I want to thank those of you who have written to me about the column. I really appreciate your encouragement. I encourage the rest of you to write with questions, comments, kudos, or brickbats. See you next month.

"Persistence" is a technical term describing the probability of a station with traffic transmitting when the channel goes clear. Right now most TNCs operate with 1-persistent CSMA. This means although a station will wait politely for another station to finish transmitting, the station will always transmit when the channel finally goes clear. The DWAIT parameter in your TNC is an attempt to prevent all stations from transmitting at once, but it introduces its own set of problems.

The problem with 1-persistent CSMA occurs when there are two or more stations ready to transmit. When the channel finally clears, they both transmit at the same time virtually guaranteeing a collision. To alleviate this problem p-persistence allows you to assign the probability p to the likelihood of a station transmitting when it has traffic to send.

In operation, when the channel clears, instead of immediately transmitting, the TNC generates a random number between 0 and 1. It then compares the generated random number with the value of p. If the generated random number is less than p then the TNC keys the transmitter. If the generated random number is greater than p the TNC waits for a period of time (called slot time) and then tries again. Slot time is selected to be longer than the time it takes for another station to key up and capture the channel.

Let's go back to our previous scenario and see what happens if both stations now run p-persistent CSMA with p set to the value 0.5:

1. Neither A nor B transmit (both generate a random number greater than 0.5)
2. A transmits and B waits
3. B transmits and A waits
4. Both A and B transmit.

Here the probability of a collision has dropped from 100% to only 33%. Imagine that you could have 3 times fewer collisions in your LAN. That means three times fewer retransmissions and greatly improved throughput.

The best value for p is a function of how many users there are on the channel. A good starting point is p = 1/(n-1) where n is the number of users on the channel.

Both AEA and Kantronics have implemented p-persistence in their TNCs. If you have the option, ALWAYS use p-persistence instead of DWAIT.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D. WA3AJR
6 Jenny Lane
Pikesville MD 21208

FCC Flim Flam

Well, a look around will show that the emphasis this month is on QRP. This is a digitally inclined column, so let's look at our low power digital transmitters—computers!

What do computers have to do with transmitting? Well, folks, other than the obvious uses for RTTY, packet, AMTOR or CW terminal, a lot!

Over the past few months I have been looking at computers. I've been focussing my search on IBM PC clones. Now, there are many items to look at in the ads—how many deca-K of RAM, the number of ports, or whether the display is compatible with a greek god. But four little words that caught my eye, and maybe yours, in many of the ads: "FCC Class B Approved." I started to wonder just what that meant.

My quest led me to the local field office of the FCC to ask the big question "What is Class B approval?" and its corollary "Is there a Class A, and do I want it?" What I found out may well surprise some of you, and will interest all of you who have a hand in computing.

Subpart J of the FCC regulations deals with computing devices. In subsection 15.801, the scope of this subpart is laid out saying, "Computers and similar electronic equipment that use digital techniques generate and use radio frequency (RF) energy for timing and control purposes. Unless proper precautions are taken, some of this RF energy is radiated into space or conducted along the power line (or combination of both) and may cause harmful interference to radio communications. This subpart sets out technical and administrative specifications to reduce the interference potential of such equipment."

It sounds like the FCC is on our side, right? Read on.

Class A computing devices aren't specifically defined. They appear to be many medical computers (not office management systems) such as CT scanners, and thrillers in the ilk of coin-operated video games. Emanations from these devices are held to tight limits (see Figure 1). Note that the lowest specified frequency measurement is taken at 30 MHz, so that the VHF and UHF bands are the most affected.

Class B computing devices are those near and dear to us. Personal computers, computer peripherals—even digital watches and calculators—are Class B devices in the FCC's eyes. Let me dispense with your concern over your watch quickly, though, as labeling regulations dispense with the requirement on an "extremely low power, miniature computing device, such as an electronic digital watch." Just as with Class A computing devices, strict field strength measurements are required for Class B certification (see Figure 2).

You might note an interesting comparison. The measurements for Class A devices are specified at a distance of 30 meters, while those for Class B are at 3 meters. That, coupled with the different field strengths, somewhat obscures the magnitude of these regulations. But, the FCC in their infinite wisdom, says that for Class A devices, "Measurement for compliance with these limits may be made at a closer distance, provided the test results are compared with the limits at 30 meters using the relationship: E30 = Ed (d/30) where, E30 = computed field strength in microvolts per meter at 30 meters; Ed = measured field strength in microvolts per meter at the distance 'd' meters; and d = distance in meters at which the field Ed was measured (less than 30 meters, but greater than or equal to 3 meters)."

Now, if you take the allowable limits for Class B devices at, say, 30 to 88 MHz, 100 µV/m at 3 meters, and plug them into the above formula, you get E30 = 100 3.30 = 10. Allowable field strength for Class A would be 30 µV/m, at 30 meters, but for Class B only 10! What appears at first glance to be looser limits for personal computers is, in fact, tighter! This is important because if someone tried to bamboozle you into believing that Class A approval is better than Class B, well, now you know better.

Frequency (MHz)	Distance (meters)	Field Strength (µV/m)
30 to 88	30	30
88 to 216	30	50
216 to 1000	30	70

Fig. 1. FCC Class A device radiation limits.

Frequency (MHz)	Distance (meters)	Field Strength (µV/m)
30 to 88	3	100
88 to 216	3	150
216 to 1000	3	200

Fig. 2. FCC Class B device radiation limits.

Letters Dept.

I have here one of those "last resort" letters I get from time to time. It's the type that say that the individual has looked everywhere for something, been unable to find it, and I am his last resort. I don't know, sometimes we get lucky. This time, though, I will have to punt to you all. Maurice Kerr, of Aberdeen, MD is looking for software to display weather FAX on a MacIntosh 512K computer. I nosed around a bit but couldn't come up with anything. Any help out there? I'll publish what information I turn up for all to benefit.

Okay, folks, who can help an enterprising RTTYer? Ralph Della Rocca WA2STO, of Oakland, New Jersey, has been working on his RTTY WAS, but is five states short. He appeals to all RTTY-oactive hams in South Dakota, Hawaii, Vermont, New Hampshire, and Rhode Island! Drop Ralph a line at 22 Hillside Avenue, Oakland, NJ 07436, if you can set up a sked. Good luck, Ralph, and let us know when you make the big Five-Oh!

Now for AMTOR. I received a question via CompuServe Easy-Plex the other day from Bud Holzschuh, of Friendswood, Texas. He recently acquired a PC clone and is totally satisfied with it except for one problem—interfacing it with his AEA CP-1. "It's easy to find programs to run CW, RTTY, and ASCII," says he, "but not AMTOR!" "No one has all-mode software for the PCs on a 'dumb' interface."

I'm sorry to say I don't know of any software AMTOR routines. Not sure if it is all a hardware or software problem, but I agree, there's either no such animal, or he's hiding pretty well. Perhaps the readers can help out. So far the PK-232 has a corner on the all-mode interface dept!

J.J. Falkanger KF4VE is another ham who sent a question via CompuServe. He has questions about the PK-232 ranging from the simple "how well does it work" to some details on the WEFAX output, his questions show the phenomenal interest in this end of the hobby.

Well, J.J., I am truly impressed. Transmitting is clearly no problem. Receiving has always been the bug-a-boo at my station, and my history goes back to a homebrew W2PAT convertor, as well as an ST-6, and several others in between—both commercial and amateur versions. By comparison, the PK-232 ranks up with the best of them. I have not found a signal that could not be copied if it was a copiable mode and if the signal could be heard.

The WEFAX reception is also remarkable. The picture I printed here was produced here at WA3AJR on a plain Epson-type printer, from the bounding signal the Navy sends up here from Norfolk. He tells me that new software allows direct display on PC screens, obviating the need for so much paper. Sounds like a good idea to me. Good luck, and let us hear from you as you progress.

Here's some hellos to the faithful readers of this column. I received quite a bit of mail over the past month or so. To Dr. James Wilson, Frank Krushina K4DW, Robert DeVaughn K3NBD, Howard Swertfager WA2ORX, Cliff St. John WA8AWU, Darrel Daley KL7DN, Jack Bentley KC8FR, Tim French KA9WDJ, Ken Taylor KC5IX, Hal Pressman KD8SY, Ray Pitts N6HDU, and all the others who have written in with this or that, thank you! It is your interest that keeps me hopping, and this column moving along.

I continue to look forward to your questions. Postal inquiries go to the address at the top of the column, and should be accompanied by a self-addressed, stamped envelope (SASE). Electronic mail is welcome via CompuServe (ppn 75036,2501) or Delphi (username MARCWA3AJR). 73

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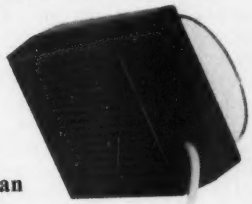

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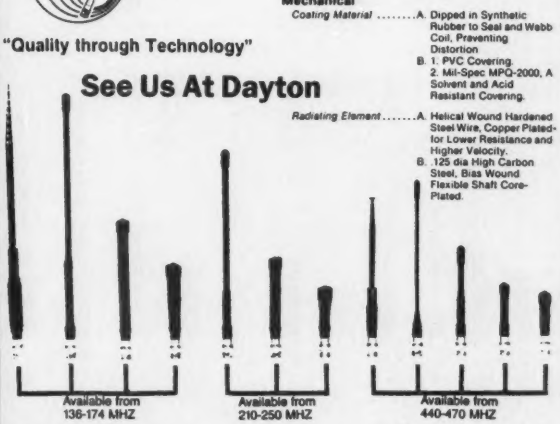

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The QRP 5er

When I was a Novice, a good friend of mine always told me to look into all those coffee cans and cigar boxes at a hamfest for hidden goodies. Well, Joe was right. At the Dayton Hamvention last year, I found a small circuit board that would become this month's project: the QRP 5er.

The name may be a bit misleading. It is not a transmitter, but a five-amp power supply. Working the world with a watt or two of RF eliminates the need for large bulky power supplies. The addition of a few more parts, and you can turn the power supply into a battery charger to keep those portable rigs perking.

The small circuit board that I found at the hamfest was a pre-regulator for a color monitor. Some guy had a box full of these boards under his table. I asked what they are and the stories started. Seems that he got the monitors from a company that made terminals for hospitals. The hospital did not want the color monitors, so he bought them in a large lot for a good price, and was selling them out like hot cakes at the hamvention. So what of the boards? Seems that the company that made the monitors was to use a 24-volt supply, but the monitors work on 13 volts. The boards were to regulate this voltage down. Since the monitors worked on 13 volts, he separated the pre-regulators from the chassis and sold them for five bucks each. The pre-regulator boards can regulate up to six amps of current. With a bit of bargaining on both parties, I walked away with a board for $2.50.

I tossed the board into a junk box after I returned home. A few weeks later, I dug it out and began the look it over. With only a few external components, the heart of this pre-regulator seems to be a adjustable voltage regulator, an LM338K to be exact. Looking the part number up in one of the catalogs that I have, it seems that the LM338K is a six-amp adjustable regulator, with a list price of $7.35. Guess I did get a bargain after all. Since the board had all the interface parts needed, I use the board as a basic building block for the power supply. Because buying the LM338K would make the project much more expensive than I would like, I'll show you how to use the LM317K, a different type of regulator. It doesn't handle as much current, but it is a lot cheaper, and you can get the TO-220 case LM317T from your local Radio Shack store.

As with all the projects that I build, nothing is cast in concrete. Substitute parts for what you have on hand, not what I have in my junk box. One of the first things we need to dig up is the power transformer. Since we will be needing at least 12 volts output, we need about 18 volts from the transformer, because the regulator requires a 5-volt buffer. When a load is connected to the supply, the regulator will hold the output at the preset voltage. If there is not enough voltage from the transformer, the output voltage will drop. That's the reason for the required 18 volts.

What Transformer to Use?

What to do if you don't have an 18-volt transformer in the old junk box? First you can go to Radio Shack and buy one—they sell an 18-volt 3-amp job for about $8 (a bit high for me). You can take one 12-volt transformer and tear it apart and rewind the secondary for a higher output, but that's really a lot of work. Fine if you're up to it, but time is money and I don't have the money for that! If you have one six-volt transformer and one 12-volt transformer, you can wire the secondaries up in series to obtain the needed 18 volts. Just connect the transformers in series and check for the proper output with a voltmeter. If you get nothing, reverse one set of leads on one transformer.

"Use wits instead of watts!"

You can also use a 24-volt transformer. I don't recommend them, however, since the excess voltage has to be dissipated as heat from the regulator.

Lastly, you can get away with using a 12-volt transformer. It's possible as long as you don't load the output down too hard. The peak-to-peak output from the bridge rectifier charges up the filter capacitor to its maximum voltage. The capacitor then acts as a buffer. If you try to pull too much current, the capacitor can't supply the regulator with enough voltage, and the output sags.

Speaking of Filter Capacitors

There's a formula for calculating the needed value, but why bother? The more the merrier. Use the maximum capacitance you can muster. Watch the capacitor voltage; get one rated at at least 30 VDC. If you can't find one capacitor to fit the bill, you can always add capacitors in parallel to increase capacitance (again, watch the voltage ratings). All of the capacitors should be rated for same voltage.

Between the filter capacitor and the transformer is the rectifier. I used a 10-amp unit with a voltage rating of 200 VDC. The entire unit is encapsulated into a small square about the size of a postage stamp. You can use individual diodes if you like, mounting them on tie strips. Go for a three- or six-amp rating. If you plan on using the supply for powering milliwatt rigs, use the very common 1N4002 diodes, rated at one amp.

Let's now look at the regulator. Pass transistors were in common use in the past, and still are in large, high current power supplies. Lucky for us, we don't need that kind of current. The LM338K will pass six amps. You can adjust the output voltage. The regulator is both current and temperature protected. You can even short the output to ground and the chip will just shut down with no damage. As I said in the beginning of the column, you don't have to

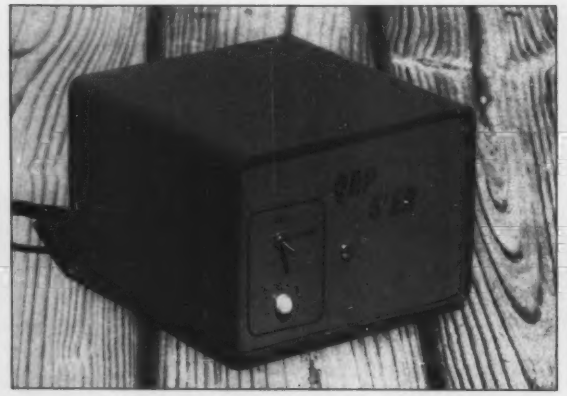

Photo A. The QRP 5er—A small 5-amp power supply just for the low-power operator.

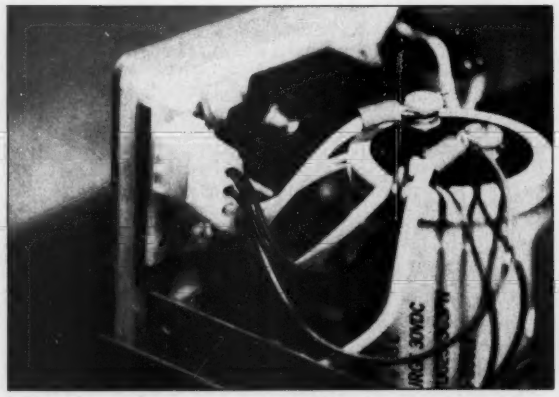

Photo B. Inside the supply. Note the Molex connector for input and output connections. Filter capacitor in foreground.

use the LM338K. The LM317K has all the features of the LM338K, but can only pass 1.5 amps of current. That is still quite a bit current for the QRP operation most of us use.

Take a Look

Look at the photographs of the completed QRP 5er. You can get some idea on how I put it all together. Since I already had the pre-regulator board with the required LM338K, I mounted it on the inside rear of the cabinet. The heat sink is clearly shown in the photos. While the LM338K can pass six amps of current, the heat sink that is on the board will not supply enough cooling for the regulator. That's fine since I don't plan to pull that much current from the supply for any amount of time.

A Molex connector supplies the output from the rectifier/filter/transformer combination to the pre-regulator board. The regulator outputs via the same Molex connector. Small plastic standoffs are used to mount the board. Since I don't have access to more of these boards, it's a one-time shot. Since you don't have one of the pre-regulator boards, try to mount the regulator on the outside rear of the cabinet. Even without an extra heat sink, the metal cabinet should provide more than enough surface area to keep the regulator cool. Mount the remainder of the parts with tie-strips. Don't forget to mount the bridge rectifier on the chassis if you plan to use an encapsulated unit. If you plan to use individual diodes, they can be mounted on tie-strips, leaving plenty of lead length so the diodes will be able to cool themselves by convection.

Photo C shows the rear of the power supply. Notice the extra switch hole. That's for a battery charging option. It will insert a diode in series with the output and then raise the voltage from the regulator, to overcome the .7-volt drop across the diode and to-keeps the battery from being discharged by the supply. Figure 1 shows the complete schematic for the QRP 5er using a LM317K. Notice the needed by-pass capacitors and the chokes. They are needed to help reduce hum when running a direct conversion rig, such as the Heath HW-7. This is known as "common-mode hum."

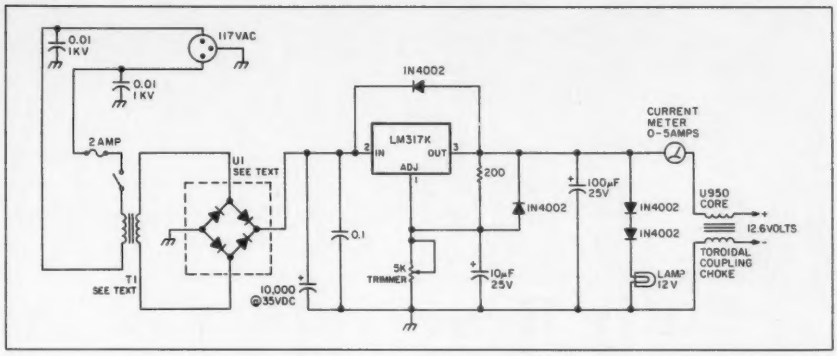

Figure 1. The schematic for the power supply. The core for the filter on the output can be just about anything. Use a large toroid or a ferrite rod.

Have you ever noticed how some hams put voltmeters on their fixed voltage power supplies? I don't know why. If you can't adjust the output voltage, why put a meter on it? A simple lamp on the output serves as a very fine voltage monitor. I inserted a few diodes in series with the lamp to reduce the intensity of the lamp. You can of course use a resistor to drop the current to the lamp, but I have a few hundred 1N4001 diodes, and the .7-V drop from each of them works just fine. With the light monitoring the voltage output, if the output sags, the light will dim.

You can easily tell if something is wrong by keeping an eye on the output lamp. If it doesn't light at all, you may have a bug in the primary of the supply or a short on the the output side. If you just can't live without a meter of some kind on the supply, then by all means, add a current meter. That will prove most useful when trouble shooting a transmitter, by seeing how much current is flowing into the transmitter. Here, you can watch for RF output to pinpoint trouble.

Most of the circuit of the QRP 5er can be changed to suit the end user. Chassis and parts size will likely determine your unit layout. Use what you have, and don't worry if you can't find the same parts as I did.

After you have everything together, look over your work for errors in wiring. Be careful dealing with the 110 VAC wiring, since you can get quite a jolt. Then, hook up a digital voltmeter to the supply output. Turn the supply on and adjust the trimmer pot for 12.8 volts. That's a bit lower than the so-called normal voltage of 13.8 volts, but reflects a closer operating voltage when running a radio from batteries. That's all there is to it! With a bit of luck, you'll have a fully operational QRP power supply to run all the upcoming projects we'll be building.

Contest Time

Winter is contest time. I received a letter from the guys up in Cuyahoga Falls, Ohio. The Crazy 8's HF, VHF & UHF contest will be held February 6 to February 7 1988. There is a special QRP section. While I don't have the space to give full details, this contest has a little bit for everyone. Even if you don't like to contest, the contests will help to fill up the logs sheets. When you're worth five points, you're always 5 x 9! These contests are great ego builders for the QRP operator.

Next month I'll look at one item that generates more fear into most hams today than the FCC could ever dream of. So until next month, remember, use wits instead of watts!■

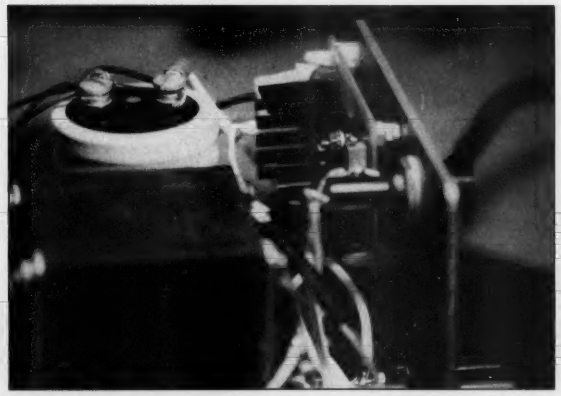

Photo C. Rear view of the supply. The extra hole is for a battery charging option.

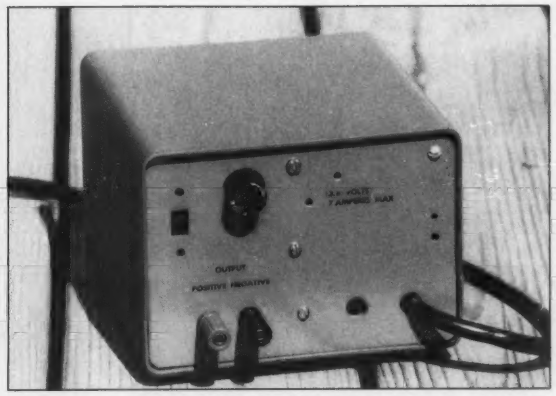

Photo D. Fuse in foreground is for the primary of the transformer.

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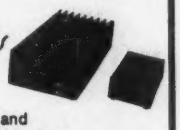

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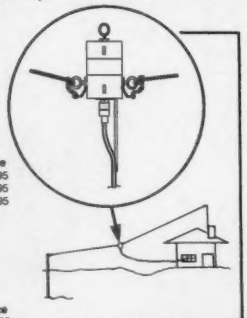

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LETTERS

From the Hamshack

What a Story!

I am a Novice of a few months, still struggling with the newness of the hobby. The word hobby does not exactly fit—it seems more than that.

I had always wanted to be a ham, but never found the time—until at 43 I became a disciplined code practioner. I became an eager Novice...but cheap. I found a somewhat-worn HW-101, tuned it up about six times, restrung, hung wires in the trees, took a deep breath, and tapped out the shakiest CQ on record.

I got a used (of course) HD-10 keyer and paddle. With my 40 watts, (approximate, since the power meter's also seen better days) I started to conquer continents on 15 meters. Awed nearly to disbelief, I worked Brazil and once even the Canary Islands! So what? Well, try to remember when you were a young and callow ham.

One evening I had a nice long QSO with a fellow from Veracruz in Mexico, XE1AKE. I was really impressed with his signal when I learned he was operating at five watts on a home brew using a vertical built in the cellar. We exchanged QSLs—his had a request.

He wrote that he was partially through a project from *73*, a one watt CW transmitter (what else?), when his car was stolen. Now he can't finish the project because his car's been stolen. How's that? Well, the magazine was in the back seat. And back issues are hard to find in Mexico.

So I called *73* and spoke to an editor. She made it very clear that they would not replace the car but that she would get a copy out to me right away to send to Mexico. Well, I talked to her yesterday, got the magazine today and am mailing it tomorrow. Let's hear it for cheerful, considerate service.

I had a lot of fun, got to talk with some nice people and had a chance to help a fellow ham. I think I'm going to like ham radio.

Joseph G. Fitzpatrick
Milford MA 01757

We always like to hear that we've helped someone out, and we always take time out to lend a hand when we can. I wonder what would happen if everyone did one good deed each week for a fellow human being. Let's try it and find out...de NA5E.

And Still Waiting

Your November "Never Say Die" really expressed what I've been feeling for the 2½ years I've been a ham. Very little real communication takes place, especially with stations outside the US. Your ideas sound good, but there is a flaw in your reasoning about DX communications. It would be nice to draw the other station out and to find out about him or her. Yet, invariably the response is, "Many stations waiting, old man. Thanks for the call. QRZ?" It seems like every DX station has a pileup—even stations in Great Britain (which anybody on 20m has worked at least 5 times). There really *are* "many stations waiting!"

Just what the thrill of exchanging "5 by 9" is, I don't know. In the days when we built our own equipment, maybe there was a pride in knowing they could hear you, but what makes my Kenwood or Yaesu better than the next guy's? Has the low propagation made DXers so hungry for any non-US contact, or is it merely force of habit? Of course, if the DX Op would ignore those stations and have a real conversation, that would solve the problem, but there is a lot of pressure on him to hand out contacts.

If you have any ideas regarding how to get the other station to *want* to talk, please tell me what it is.

Michael Jay Geir KB1UM
S. Burlington VT

Michael, I've seldom had a problem getting DX ops to talk to me. The strategy is simple: Ask them a question that gets them interested in talking. My opening is simple—I'm hoping to visit their country/city/town and would enjoy meeting them. I not only get a phone number to call if I get there, I get a description of their area and plenty of attention. I get a real contact instead of just a QSL. Now don't steal my gambit, you think up something of your own to ask that will get them talking...Wayne.

Dear Mr.

As General, Advanced, and Extra Class you have 12 groups of frequencies for talking. Novices have 3 restricted-to-death areas people begrudge them. It must stem from an abuse cycle—the good old days of the gagged Novice you had to endure, and having to know everything a General did to pass Technician. Seeing the Novice class change and Tech get easier must make you steam. How dare *they* get things handed to them—like voice. So you feel you must abuse and insult these people so that they will know the worth of the abuse you took in the dark ages of amateur radio.

The dark ages are gone, but you wish to keep the Novice in bondage to an ancient way of life—out of step and foolish. Ours is a keep-pace, high-tech, and stress-filled world. Amateur radio was supposed to be a hobby that benefits the operator and the public at large—not a private thing to be hidden, kept secret, and hogged. Instead of encouraging wide-eyed Novices of many ages, sharing knowledge, and gaining new friends, you choose to keep yourself isolated, unknown hermits in a high-tech hobby.

We recognize your accomplishments and your hermit pals know who you are, but does the guy down the street or that wide-eyed kid you passed just a moment ago? In most cases, no. And your accomplishments—unknown and lost forever. What pride is there in being unknown—your knowledge and skills dye with you. A sad waste—skilled Masters of Amateur Radio, artist and art, lost and being lost every day. Silent keys, an unkeyed mike—no one there to pick up the mike or pound the brass after you're gone. Novices are eager and willing to listen and can apply themselves. If they couldn't they wouldn't be trying to enter a hobby from which selfish and heartless people are trying to exclude them. Are you a teacher or a silent master with no apprentice?

Amateur Radio
(The Next Generation)

Guilty as charged! The Grand Order of Ignoble Amateur Radio Operators have perpetrated the arrogant notions of elitism and fraternal pecking order long enough. The Next Generation will soon leave them long behind in death (see "Silent Keys" in QST) or in ignorance, whichever comes first. At the same time, let's not forget the thousands of unsung Elmers, who have kept this hobby alive and growing despite the efforts of others. Live long and prosper...de NA5E.

Anybody Home?

I have been an amateur radio operator since November of 1982. I presently hold an Advanced class license. On 10/03/87 I checked into a late net on 75 meters. During the course of the net a station in Tennessee made his call to a station in Hawaii. After an unsuccessful first attempt, the net control station and two relay stations across the country told the KH6 to "listen for a call." At the end of the second transmission the net control started a relay of "overs" and "send a string of numbers" back to the KH6. After a relay of "overs" came back from KH6 the 2 x 2 QSO was confirmed by the net control station.

It appears very obvious from the set up of relays across the country that neither station heard the other, but a standard 2 x 2 report on each end was enough to get a "roger contact" from the net control. I am working for my WAS and would like to get it very much, but not under such operating practices. If this is what getting a certificate is all about then it truly is *wallpaper*.

After questions were asked about the validity of the contact by this station and others, Tennessee asked net control to withdraw his contact, thus helping to restore some faith in the ethics of amateur radio operators. This makes me wonder how many contacts have been made under similar circumstances and have not been questioned as this one.

I hope this note reminds amateur radio operators that this is a hobby, for fun—you are not a better operator just because you have a lot of paper hanging on the wall.

Gary Mascelli, Jr. N3DLM
Wilmington DE

To claim credit for clearly incomplete contacts is dishonest at best, no matter what method an operator may use. The fundamental problem is not new, nor is it limited to amateur radio. If any operator gleans satisfaction from dishonest practices, whether his own or someone else's, he joins the ranks of universal sleaze bags, unworthy of anything more than a turn of the dial...de NA5E

Dx

Hams Around the World

Chod Harris VP2ML
PO Box 4881
Santa Rosa CA 95402

Three Ways to Find Solar Minimum

Solar research uses three measures to pinpoint the solar minimum. The most obvious is the number of sunspots: when that number is at its lowest point in the 11-year cycle, we are at the solar minimum. Short term fluctuations in solar activity, however, make the monthly sunspot count gyrate from near zero to the high 30s. For example, the sunspots counts for September and October 1986 were 3.8 and 35.4, respectively. That's an increase of a factor of nine in a single month!

Researchers smooth out these month-to-month variations by using a 13-month moving average. The smoothed sunspot number for a given month is the average of the sunspot counts for 13 months centered on the given month, including six months before and six months after that month. This means that scientists (and DXers) cannot determine the smoothed sunspot number for six months after the month in question.

The smoothed sunspot count dipped to 12.3 in September 1986, its lowest value in 10 years. Since sunspot cycles usually bottom out at much lower sunspot numbers (5–7 is more typical), some solar experts hesitated to call the September figure the true bottom of the cycle. However, after September, the smoothed sunspot value began to increase, doubling to 24.2 in only seven months.

A second method to determine solar minimum uses the cycle period. Solar cycles average 10.9 years in length. Since the last solar minimum occurred on June 1976, we should have reached another minimum in mid-1987.

This system is limited, though, by the cycle's irregular period. Solar cycles have ranged in length from as little as 7 to as long as 17 years, so this method can provide a rough approximation of the bottom at best.

Mixing Old and New

A final way to identify the solar minimum is when "new" and "old" cycle sunspots are approximately equal in number. How can you tell the difference between new and old cycle spots? During a solar cycle, sunspots first appear at high solar latitudes, 30 degrees or more north and south of the solar equator. Over the next 11 years, new spots tend to form ever closer to the solar equator, so that near the end of the cycle, what few spots arise tend to lie clustered close to the center of the sun.

Further, the magnetic field of the sunspots reverses with each new cycle. Thus, "new" cycle spots have a magnetic orientation opposite to that of the spots near the solar equator. This means sunspots associated with the upcoming cycle can be easily identified.

Sunspots from the two cycles tend to overlap for about two years. We begin to see new cycle sunspots about a year before solar minimum. At the minimum, the numbers of new and old cycle spots are about equal. After the minimum, new cycle spots predominate.

The first Cycle 22 spots appeared in August 1985, which gave DXers hope that the solar minimum was only about one year away. However, few Cycle 22 spots appeared over the next few months, giving rise to the fear that the first spots were more similar to a groundhog predicting six more months of solar Winter than a robin heralding the coming solar Spring.

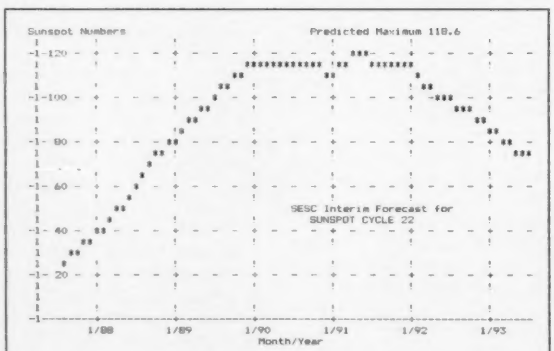
Cycle 22

Through the fall of 1986 and into spring 1987, the number of sunspots continued to increase, and most of the increase came from new cycle spots. The number of old cycle spots dwindled down to near zero, an excellent indicator that we had, indeed, passed solar minimum.

Why all this concern about when the cycle bottomed out?

Because predictions of the next solar cycle are very dependent on the exact date of the minimum. When will the sunspots be high enough for world-wide 10-meter propagation? Will the maximum usable frequency rise high enough to open 6 meters? The answers to these questions hinge on the date of the sunspot minimum.

Based on the September 1986 minimum, solar researchers have predicted a sunspot maximum for Cycle 22 of about 120, to occur in early 1991. This number is way down from the peak of 165 we enjoyed in December 1979, the last solar maximum. The low predicted value is based on evidence that even-numbered cycles are lower and flatter than odd-numbered cycles. This difference may reflect a 22-year sunspot cycle, rather than an 11-year cycle. Some solar scientists feel that a full solar cycle consists of two peaks and two minimums. The full cycle thus incorporates two 11-year cycles. (See Sky and Telescope, June 1987, for more details.) The even numbered cycles (18, 20, 22, etc.) have been characterized by lower peaks than the odd-numbered cycles, which leads to the prediction for a sunspot peak in the 120 range.



Month	SSN	Month	SSN	Month	SSN	Month	SSN
1/87	16.3	1/89	81.4	1/91	111.8	1/93	85.5
2/87	17.3	2/89	84.9	2/91	112.8	2/93	82.9
3/87	18.6	3/89	88.1	3/91	115.3	3/93	80.5
4/87	19.9	4/89	91.2	4/91	118.0	4/93	78.5
5/87	21.5	5/89	94.2	5/91	118.6 *	5/93	76.9
6/87	23.0	6/89	97.3	6/91	118.0	6/93	75.5
7/87	24.4	7/89	100.3	7/91	117.3	7/93	74.2
8/87	26.3	8/89	102.9	8/91	116.1	8/93	72.5
9/87	28.5	9/89	105.2	9/91	114.2	9/93	69.7
10/87	30.4	10/89	107.7	10/91	113.0	10/93	67.4
11/87	32.6	11/89	110.7	11/91	112.7	11/93	66.8
12/87	35.9	12/89	113.5	12/91	113.3	12/93	66.2
1/88	39.5	1/90	114.6	1/92	112.8	1/94	65.5
2/88	42.0	2/90	115.4	2/92	110.4	2/94	64.5
3/88	44.6	3/90	115.5	3/92	107.1	3/94	63.3
4/88	47.8	4/90	114.8	4/92	103.7	4/94	61.8
5/88	51.1	5/90	114.8	5/92	101.5	5/94	59.4
6/88	55.1	6/90	114.4	6/92	100.2	6/94	56.5
7/88	59.8	7/90	113.9	7/92	98.7	7/94	53.5
8/88	64.3	8/89	113.9	8/92	97.3	8/94	51.2
9/88	68.6	9/90	114.3	9/92	96.4	9/94	49.9
10/88	72.6	10/90	114.8	10/92	94.9	10/94	48.6
11/88	75.7	11/90	114.3	11/92	91.8	11/94	46.8
12/99	77.9	12/90	112.4	12/92	88.6	12/94	44.7

* denotes maximum

Figure 1. Graph and table of sunspot numbers for Sunspot Cycle 22 for January 1987 to December 1994 (courtesy of Space Environment Services Center).

Looking Ahead

The good news for DXers is that the even-numbered cycles rise quickly to their peak, and stay at high sunspot levels for several years. The predictions for Cycle 22 have the sunspot number climbing to the 120 range as early as the end of 1989, and staying that high until early 1992. Although this is probably not enough sunspots to open 6 meters on a regular basis, 10 meters should be excellent throughout this period of high solar activity.

More good news for DXers is that the sun is running well ahead of predictions in Cycle 22. The smoothed sunspot number jumped to 24 only six months into the new cycle. The only other sunspot cycles that climbed so rapidly at the beginning went on to produce record-breaking sunspot numbers at their peak.

It's still too early to say whether Sunspot Cycle 22 will be another great one, such as the late-50s peak, or the one in the late 1970s.

For more information on solar cycles and prediction methods, see Shortwave Propagation Handbook, by George Jacobs W3ASK and Ted Cohen N4XX. Also, WWV transmits solar activity data at 18 minutes after the hour. Modem-equipped DXers can obtain current solar data, summaries of the previous month, and predictions of Cycle 22 by calling The Space Environment Services Center data line 303/497-5000 at 1200 baud, 8 bits, one stop bit, no parity. 73

QTH DX

QTH is Nauru

We welcome N6HYK's new, regular feature to our pages. Mr. Fletcher is a professional writer and an active ham. He has traveled to more than 160 countries. Through his efforts, we hope to fill you in on some of the more interesting aspects of those rare DX spots...Ed.

Leon Fletcher N6HYK
274 Webster Dr.
Ben Lomond CA 95005

When you work a C21, Nauru, you're in touch with a resident of the country with the highest per-capita income in the world—*and almost none of its citizens work!*

While it is rather widely known that the wealth of Nauru comes from mining the island's high-grade phosphate—bird droppings—few outsiders know much about the impact that valuable resource has made on the islanders.

The phosphate has come from uncountable birds nesting on the island for millions of years. Nature has mixed the phosphate with the island's coral to produce a truly superior fertilizer.

The deposits cover about a third of the island—but are expected to be completely mined out in the mid-1990s. By then, however, if the government's plans work, every citizen should be a millionaire.

Every year the government invests some 60% of the mining profits in such adventuresome projects as:

Air Nauru, an airline that carries passengers first-class only.

Five (at last count) cargo ships operating under the flag of the Nauru Pacific Shipping Line.

The tallest building on Saipan, a 7-story structure topped with the only revolving restaurant in the far Pacific.

And the tallest building in Melbourne, a 51-story office complex called by Australians—in salute to the source of the funds for the structure—"Birdshit Tower."

The other 40% of the income is distributed to the citizens of Nauru. Housing, education, hospitalization, and such are all free. Postal rates are the lowest in the Pacific. The per capita income is $21,400—more than 83% higher than the $11,675 in the United States. The Nauruans pay no taxes.

With such riches, few of the 4,500 Nauruans work. The mining—and virtually all other work on the island—is done by some 3,500 hired hands from other Pacific islands and from China.

Some Work, Some Play

While those workers toil, Nauruans play. The QSL card of *C21RK*, Reuben (Jim) Kun, features the drawing of the large bird and this printed note:

"The frigate bird is native to the Pacific Islands. Traditionally, they are caught and tamed by Nauruians. They are then kept as pets. The tame bird can fly long distances and bring back other wild frigate birds, which are then caught by a weighted line."

Another diversion that attracts bored Nauruians is the island's airline. The *nouveau riche* islanders frequently squander their funds on one-day, round-trip flights to neighboring islands. Once there, many of these travelers don't bother to sight-see, shop, dine out, or do any of the other usual tourist activities; they often do nothing but hang around the airport, waiting for a return flight. According to travel writer David Stanley, Nauruians consider the trips "one way of passing the time."

Island Paradise?

The island's single road, which has only a few offshoots, is often jammed with large American cars and 4-wheel-drive Jeeps. Super-loud, raucous music blasts from stereos, shattering the peaceful atmosphere of pristine beaches. The supermarket sells a great variety of imported junk food. The result: many Nauruians are obese. In Stanley's view, "There is widespread evidence of affluence and accompanying wastage."

At eight square miles, Nauru is the third smallest country in the world. Only the Vatican and Monaco are smaller. A major activity for visitors is to walk around the entire country—but that takes only about four hours. The island is 12 miles in circumference, oval-shaped, surrounded by a coral reef visible at low tide. Inside the reef is a beautiful beach of sparkling white sand. Seaward, the bottom drops away at a startling 45 degrees. There is no harbor, but the 30,000-ton ships calling regularly to carry away Nauru's valuable resource tie up offshore at what are claimed to be the deepest moorings in the world.

"They could easily buy another island for themselves."

The island is located in the Western Pacific, some 5,400 miles southwest of California, 1,300 miles northeast of Australia, 30 miles south of the equator. The nearest neighborsare more than 400 miles away, on the Gilbert Islands.

But it is the future of Nauru as an island that is debated by ecologists, engineers, and local legislators. Some say when the phosphate runs out the island will be uninhabitable and the residents will have to move off. They might move in with the citizens of another island, or—by dipping into the country's hefty bank accounts—they could easily buy another island for themselves.

Other observers claim that once the droppings are gone, a beautiful tropical paradise—a tourist's dream—could be built on the desolated island. Again, the expense would be relatively minor for the government's substantial wealth.

Currently 1988

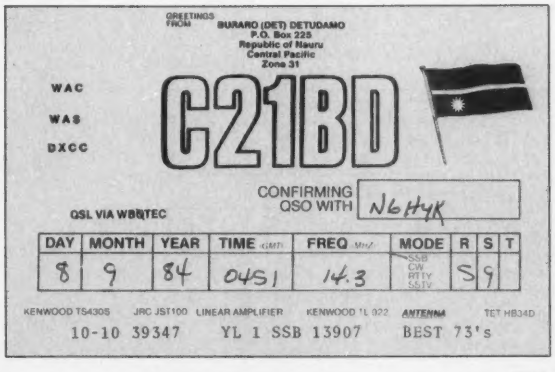
There are 14 hams licensed on Nauru, and all have calls with a 2-letter suffix of their own initials—except John Bill, who cornered the enviable *AA*, and Robert Detudamo, who wangled the desirable *DX*. There's also a club station, *C21NI*–the suffix standing, of course, for *N*auru *I*sland.

The QSL card from *C21FS*, Frank Smith, calls Nauru the "Pleasant Island." That was the name given by British Captain J. Fearn in 1798, when his whaling ship was the first European vessel to visit the island. In 1886 Germany annexed the island but after World War I, it became a League of Nations mandate administered by Australia. During World War II, Japanese occupied the island and sent 1,200 Nauruians to slave labor on Truk. In 1947, Nauru was made a United Nations Trust Territory. Finally, in 1968, Nauru gained its independence.

A few years ago I sailed to various Micronesian ports aboard one of the Nauruian cargo ships, the *Enna G*. Of the 80 man crew, only a few were from Nauru. Shipboard work—any kind of work—interests few Nauruians. Most were simply seeking paid visits to other islands. Working their way up the ranks of their country's merchant marine was clearly not their goal.

Rarely did the ship make her home port. Mostly she carried hardware to Ponape, cars to Truk, staples to Saipan, and other cargo elsewhere. But for more than a year now, the ship has been semi-laid-up in Majuro, a skeleton crew keeping her barely operational while her future as an investment is debated—slowly—by her nation's leaders back on Nauru.

Still, while that ship rusts away, losing money every day, the typical Nauruian citizen continues to fish, swim, loaf, and tame those frigate birds, apparently worrying not a moment about his or her projected future as a millionaire. 73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AERIAL VIEW

Antenna News

Arliss Thompson W7XU
7314 SW 28th Ave.
Portland OR 97219

What Is SWR?

This month's column delves into the mysteries of SWR with as little math as possible. But first . . .

A Few Definitions

Let's define our terms. I'll be using the terms "power" and "energy" somewhat interchangeably, as many hams do, although strictly speaking they are not the same. For our purposes, the "line input power" means the power that is actually delivered into the transmission line by a transmitter. "Reflected power" is the power that is (you guessed it) reflected back towards the source whenever an impedance mismatch is encountered. Reflected power is real power, but more on that later. We calculate the percent of power that is reflected by using the formula:

$$\% \text{ power reflected} = (SWR - 1)/(SWR + 1)^2$$

"Forward power" is the sum of the line input power and reflected power. Lastly, we can define the SWR of a resistive system to be:

$SWR = R/Z_0$ or $= Z_0/R$ (whichever is greater),

where R is the load resistance and Z_0 is the characteristic impedance of the transmission line. There are also formulas to calculate the SWR in the presence of reactance, but I'll leave those for some other time.

Some Examples

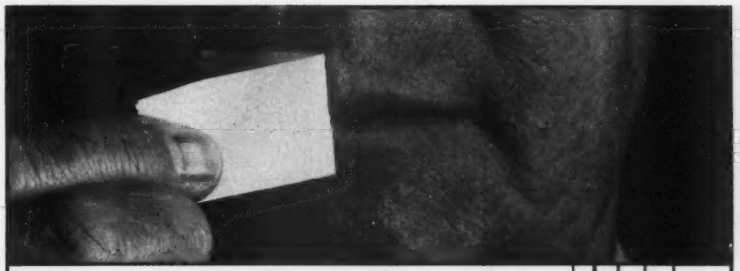
The figure shows a typical station setup, with a 100-watt transceiver designed to work into a 50Ω system, a directional wattmeter (wattmeter A), an antenna tuner, a 50Ω coax feedline, and an antenna. An atypical item is that for the time being we'll assume that the transmission line has no losses. I have also added a second directional wattmeter (wattmeter B) in the transmission line between the antenna tuner and the antenna, since readings from it will help to explain what's occurring in this system when we transmit. We also need to specify that our antenna is a perfect 50Ω resistive load on the frequency we will be using.

What happens when we key the transmitter? Since we don't know the antenna tuner settings, we can't predict what will initially occur, but by adjusting the antenna tuner we should be able to get wattmeter A to show 100 watts of forward power and 0 watts of reflected power. What will wattmeter B read? It will also show 100 watts of forward power and 0 watts of reflected power since there is no mismatch at the junction of the feedline and the antenna; i.e., they are both 50Ω.

What would happen if we replaced that 50Ω antenna with one that had a resistive (no reactance) impedance of 100Ω? Key the transmitter and adjust the antenna tuner. What do you read on the wattmeters? If you have properly adjusted the tuner, wattmeter A should read 100 watts forward and 0 watts reflected. Wattmeter B will now show some reflected power, however, because there is no longer a perfect match where the feedline and the antenna join. In a moment we will calculate just how much reflected power would be present. But first, take a look at the forward power indicated on wattmeter B—it's reading 112.5 watts! How can there be 112.5 watts of forward power when wattmeter A tells us that the transmitter is only putting out 100 watts?

What's Going on Here?

In order to answer this question, let's first go back and calculate how much reflected power would be present in this situation. Imagine that the transceiver has just been keyed, and we are following that initial pulse of energy as it travels down the feedline. All goes well as the pulse flies down the transmission line until it encounters the antenna. Now, however, instead of seeing a 50Ω feedline, it is faced with a 100Ω antenna. Whenever electromagnetic energy encounters an impedance mismatch, a portion of that energy is reflected. That principle explains how you can see yourself in a mirror—the air and silvered glass present widely different impedances to the transmission of light and so much of the light that strikes the mirror is reflected.



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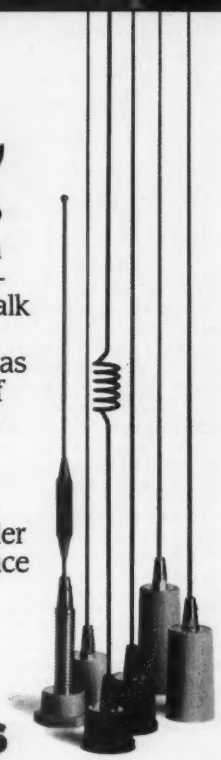

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When the energy in the 50Ω feedline meets a 100Ω "obstacle," a portion is reflected back toward the transmitter. Since the SWR is 2:1 (100/50) and the line input power is 100 watts, the reflected power will be 11.1 watts:

$$\% \text{ power reflected} = ((2-1)/(2+1))^2 = 11.1\%$$

$$11.1\% \times (100 \text{ watts}) = 11.1 \text{ watts.}$$

Therefore, the antenna will absorb 88.9 watts (100 - 11.1), and the reflected power will be returned toward the transmitter. But then what happens?

Before the reflected wave can reach the transceiver, it encounters the antenna tuner. Since we adjusted the antenna tuner to eliminate any reflected power between the transmitter and the tuner itself, we automatically created a situation where all of the reflected power would be re-reflected, and once again be heading toward the antenna. Also, due to associated phase changes that occur with reflection, the reflected voltage and current that make up the reflected wave are in-phase with the power coming from the transmitter.

Therefore, as we once again pass by wattmeter B, its forward power meter will read the original 100 watts plus the 11.1 watts of now twice reflected power. When we arrive at the antenna, 88.9% of the arriving power is radiated by the antenna, just as before, but now it's 88.9% of 111.1 watts, or 98.8 watts total. Since our transmitter is only emitting 100 watts, that leaves 1.2 watts to be once again reflected toward the transmitter and the antenna tuner. That 1.2 watts combines with the 11.1 watts present from the first reflection to yield 12.3 watts of reflected power. Then it's the same story all over again: the 12.3 watts is re-reflected at the antenna tuner and combines with the 100 watts being emitted by the transceiver. The forward power meter of wattmeter B edges up to 112.3 watts, while the reflected meter reads 12.3.

This cycle of reflection and re-reflection continues (at nearly the speed of light) until (and this is very important) all of the 100 watts emitted by the transceiver is radiated by the antenna. At that point wattmeter B will be indicating 112.5 watts of forward power and 12.5 watts of reflected power. All of the power "lost" due to reflections at the antenna is regained at the antenna tuner when the reflected power combines in-phase with the forward power. This is true whether the SWR is 2:1 or 20:1. The presence of a large

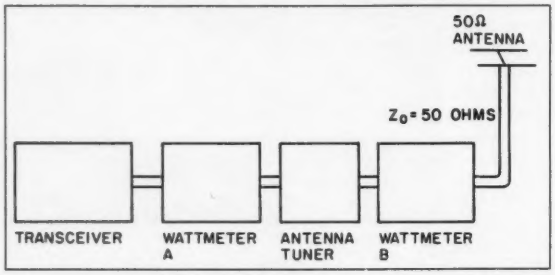

Fig. 1. Test set-up for checking forward and reflected power when the antenna impedance matches the impedance of the transmission line.

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CCS, Inc. will also be including Ham.Com, an Amateur Radio communications program, with each HR8810 shipped. Ham.Com is fully interrupt driven to virtually eliminate birdies caused by long instruction loops. The program provides computer control of Kenwood 440s and 940s, a separate-screen notepad, voice synthesizer emulation for the vision impaired, 30 user definable macros, PK232 control, a QSO file, ASCII and Binary file transfer, and much more. A very good program, it is a welcome addition to our complete system. Another Ham computer communications program is available with the HR8810 as an option. ExpertQ from Expertedge offers the operator more radio and TNC options, FAX, a three time zone time window, 40 function keys, 26 rapid access memory buffers, and more. Highly recommended by many, ExpertQ is available as an option for an additional $50.

The HR8810 includes a 4.77/10 mHz motherboard with 640K RAM, two 360K floppy disk drives, Hercules monochrome graphics controller card, 14" CTX monochrome high resolution TTL monitor, two serial ports, one parallel port, one game port, clock/calendar with battery backup and floppy disk controller, AT enhanced style keyboard, three shielded interface cables, and a Command Center providing surge, spike, EMI, and RFI filtering. The computer is housed in an AT jr. style case with keyboard lock, turbo button, and hardware reset. The system includes MS-DOS 3.21 and the communication software Ham.Com. The cost of the HR8810 as configured above is $1050 and is available in kit form at a reduced price. Of course, if you would prefer a different configuration we can custom build it to your specs for only the difference in price of components.

For more information on the HR8810, custom programming, available software, expansions, and all of CCS, Inc. products and services call, write, or use the reader service card.

CIRCLE 191 ON READER SERVICE CARD

ed in dirt theory, you don't know quite what to make of the situation, but when the boss comes around and chews you out for not getting as much dirt into the antenna pit as you normally do, you start working harder and decide to do some studying when you get home.

The next morning you show up for work armed not only with a shovel but also with a "pit tuner." The pit tuner is a special device that catches the dirt that the gremlin is throwing back onto your pile and diverts it onto the conveyor belt (feedline). Last night you had read how some people in this situation had gone to the bother of erecting the pit tuner out near the pit itself, but you correctly reason that it would be handier to have the pit tuner near your working position so you could readjust the tuner if need be.

With the tuner in place, you start shoveling at the same pace you've become accustomed to over the years. You can't even see the gremlin with the pit tuner blocking your view, but so long as the tuner is functioning you know that all the dirt you place on the feedline is making it to the antenna pit. True, that gremlin is out there taking dirt off of the conveyor belt and carrying it back to the pit tuner, but it doesn't matter anymore because when the whistle blows at the end of the day all of the dirt you've been shoveling ends up in the antenna pit.

You might even impress your boss if he looks only at how much dirt is on the conveyor belt, since he will see not only the dirt that you've been putting on the belt, but also the gremlin's dirt that the pit tuner diverts back onto the belt. If your boss was as clever as you, he would know to subtract out the gremlin's reflected dirt when trying to estimate how hard you were working, but having never read about dirt theory, he can only marvel at the amount of dirt on the feedline/conveyor and wonder why the pit isn't receiving any more dirt than normal.

Months go by. By this time you have become quite comfortable with the gremlin because you know that he really isn't doing you any harm so long as you keep the tuner in place. Then one day the boss drops by and complains because not enough dirt is falling into the antenna pit. You're puzzled by this because you know that you have been working as hard as ever. Taking a peek around the pit tuner, you see that the feedline has become worn and dirt is falling out onto the ground, never reaching the antenna pit. As if that were not bad enough, you also notice that the gremlin is spilling dirt onto the ground also. Of course, the more reflected dirt that the gremlin handles, the more that is lost. It quickly becomes apparent to you that the gremlin is now a more serious nuisance than he once was, because now you'll have to start working harder if you're going to keep the standard amount of dirt flowing into the antenna pit.

A similar situation exists in the radio world when you use a lossy feedline; a large component of reflected power can cause considerable heating of the line. Under those circumstances SWR becomes more important, because it may increase losses to an unacceptable level. So what are your options?

Option one is to live with it. Sure, the extra losses due to the gremlin being there may mean a cut in pay, but you earn more than you need, so who cares? Option two is to work harder, increasing line input power, making up for any losses due to dirt slipping through the cracks. Option three is to use a higher quality feedline so that less dirt is lost. Option four is to decrease your losses by moving your operation closer to the antenna pit, thereby shortening the length of the feedline. Option five is to get rid of the gremlin, or at least slow him down, so not so much dirt is lost due to his presence. The analogous solutions in radio are obvious.

So, is reflected power real? Of course it is! If it wasn't you wouldn't be able to see yourself in a mirror. Reflected power meters wouldn't function if reflected power was not real—it takes power to make that needle move on your wattmeter. An open-circuited transmission line represents a mismatch if ever there was one. When power is applied to such a feedline there is 100% reflection of the power reaching the open end. Why should we believe that the outgoing power is real but the reflected power isn't? The answer is that we shouldn't, because the reflected power is every bit as real as the forward power. If all this is unfamilar to you, or if you are simply looking for a review of the subject, I refer you to the excellent series of articles, entitled "Another Look at Reflections," authored by M. Walter Maxwell (beginning in April 1973 QST, p.35). ■

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CIRCLE 191 ON READER SERVICE CARD

The Challenge of Low Frequency DX'ing

Low frequency DX'ing is an increasingly popular interest among today's radio amateurs, and with good reason. The challenge and excitement of working the world on 160 or 80 meters reflects an admirable blend of skillful operating technique, outstanding antenna installation, and superb equipment performance. Each of these areas must be top-notch and work in tandem, especially when operating near the AM broadcast band range of 160 meters. Deficiencies in one area place a high compensating responsibility on another area. Yet, with a good understanding of gray line DX'ing, a quarter-wave sloper or quarter-wave vertical and a transceiver with separate transmit/receive antenna connections, adjustable noise blanker, and variable selectivity, working 100-plus countries on low frequencies is a thrill beyond comparison.

The prime times for low frequency DX'ing typically coincide with daily ionospheric changes, or when one end of a path is near dusk/dawn and the other end is experiencing cool evening propagation. As the leading edge of those brief openings are influenced by the sun's early/final daily rays **distant signals rise above a band's noise level and intercontinental communications are optimum.** Advantageously using that phenomenon is often described by serious DX'ers as being on the right frequency at the right time. Improving the odds in that game of chance includes following DX bulletins plus exchanging notes with other DX'ers. Transceivers with fully tunable and independently reprogrammable memories are also extremely beneficial for these times-conscious activities. You can tune a particular range, snap a received station into one memory, select another memory, and continue the search while awaiting your opportunity to contact the previous station. **A "DX window"** and split frequency operating concept is often utilized on 160 meters. By Gentleman's Agreement, non-U.S. stations transmit without QRM in the range of 1825 to 1830KHz while listening on a separately announced receiving frequency. Dual VFOs are thus highly desirable.

Popular antennas for serious low frequency DX'ing are slopers and shunt-fed towers for transmitting, and long wire beverages for receiving. The sloper consists of a quarter-wavelength of wire connected to a coax feedline's center conductor with the coax shield usually connected to the station's tower. When space is limited, the sloper is used for both transmitting and receiving. Shunt-feeding a beam antenna's tower involves installing a long gamma-matching rod and feedpoint tuning unit. A network of 12 to 120 quarter-wave radials creates a vital and very effective ground system, and heavy copper strapping is used for interconnecting indoor/outdoor station items. The high noise susceptibility of vertical receiving antennas is sidestepped by using a one to four wavelength-long wire erected at a constant height of two to ten feet above ground, and terminated with a 500Ω carbon resistor. A 1:9 ratio matching transformer is utilized at the (opposite) feed point end for matching this receiving antenna to 50Ω coax.

Understanding the previously discussed criteria, **a rear panel socket is included on ICOM HF transceivers for bypassing T/R switching circuits and connecting a separate antenna directly to the receiver's input**. Transmitting and receiving antennas should be positioned for minimum cross-induction, and a "front-end protection" circuit should be included near the receiver's input socket.

A suggested protection circuit is shown in Figure 1. The silicon diodes are type 1N914 or equivalent, and serve as a basic limiter to clamp high RF energy levels at the receiver's input. The pilot lamp is a low-current type (number 47 or similar) and acts as a fuse to avoid high induction current damage. The overall circuit encourages confident and smooth low frequency DX'ing.

While older style transceivers might initially seem fine for low frequency DX'ing, such is not necessarily the case. Passband tuning, IF level notch, and a continuously adjustable noise blanker, for example, are vitally important for combatting the unique types of low-band interference. A panel-selectable receiving preamp for beverage use and balanced RF/mixer circuit designs also support high sensitivity, wide dynamic range, and low noise floors. **ICOM's industry-leading designs in these areas are a world-recognized standard of reference.**

The classic amateur radio proverb, "If you can't hear them, you can't work them," is especially true in low frequency DX'ing, and the cornerstone to that success is operating flexibility with superb performance equipment. ICOM's innovative HF transceivers stand proud in this area with professional performance, superb reliability, and incomparable customer support. You're free to chase the "rare ones" with maximum confidence. Ready to experience the challenge and excitement of low frequency DX'ing in top style? Tune in with ICOM and enjoy DX'ing with a winning edge!

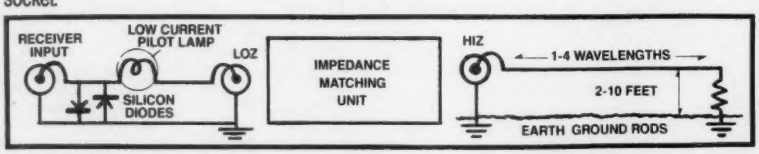

FIG. 1: Front end protection circuit and beverage receiving antenna for low frequency DX'ing.

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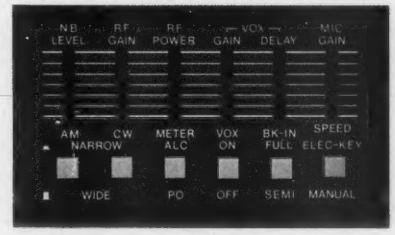

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73 INTERNATIONAL

Edited by Richard Phenix

NOTES FROM FN42

Happy New Year, China! (Year of the Dragon begins on February 17th); its Lantern Festival is on the 3rd. New Zealand celebrates Watangi Day on the 6th; there are four Independence Days in February: 4th—Sri Lanka, 7th—Grenada, 18th—Gambia, and 27th—Dominican Republic. It is Constitution Anniversary in Mexico on the 5th. Other dates to remark upon in DX contacts, 8—Revolution Day, Iraq; 11—National Holiday, Iran, Founding of the Nation, Japan, Youth Day, Cameroon; in the U.S. on the 12th, 14th, and 15th are Lincoln's Birthday, Valentines's Day, and Washington's Birthday; 18th—Democracy Day, Nepal; 23—National Day, Guyana; 25—National Holiday, Kuwait, Victory Day, Czechoslovakia; and the 28th is Kalevala Day in Finland.

ROUNDUP

Response to the idea of developing a Universal Application form for requesting operating permits has been enthusiastic. The first responses, from ZL2VR, SM0COP, PY1APS, VK9NL, and 4X1MK, among others, will be reported next month. Meanwhile, see box for special information required by some countries—more of these each month in 1988.

The EEC (European Economic Community) has undertaken a project called Eurotra, developing a PC that will simultaneously translate documents into the organization's nine official languages—providing the documents stick to the 20,000 terms programmed. (*El Pais*, Madrid, quoted in *World Press Review*.) *Wouldn't that be a handy gadget for CQ DX calls to India, if it could be converted to cover listeners who might be speakers of any of that country's 16 major languages!* It should save money. According to *The Economist*, London, translations and interpretations in the EEC use up a third of the annual budget of two billion dollars. Some 800,000 pages get translated at a cost of $500 per page. Money saved would be available to other EEC projects such as "Framework," a program "to weld the brainpower of the Community's 12 nations into a single force to take on the US and Japan in every department of industry" including the communications fields. Planners for the future of information technology and telecommunications will have to keep an eye on EEC activities!

Argentina (via Peru): Along with his re-subscription to *73* ("I believe I can take a chance with your fine magazine again, Wayne!"), Dr. L.M. Moreno Quintana (h) LU8BF/OA4QC (see photo), Consulado General de la Republica Argentina, writing from his Embassy in Lima, Peru, brings us up to date on his activity as Argentina's delegate to the 1st to the 5th Conferences Interamericana of Telecommunications. In the 3rd, with Silent Key PY1AX, Mario Romero (Peru), and Pollini (Chile), the idea of the "Lima Convention" was born. In the 5th, with the help of Gustavo OA4AJ, longtime secretary of the IARU, the Lima Convention was approved. Now, if you are an American ham and you have a valid American license (no matter whether or not an American country was your birthplace), you can apply for the same kind of license in another American country. This means there is no longer need for reciprocal licenses between American countries.

LU8BF also writes, "I was also in Nairobi, Kenya, in 1982 at the Plenipotenciaries Conference of the International Communications Union. I operated several times 5T4ITU, put by the Radio Society of Kenya at the disposal of

LU8BF/OA4QC (right) with Jorge Taboada and Armando Garcia.

SPECIAL INFORMATION REQUIRED WITH SOME PERMIT APPLICATIONS

If you use the proposed Universal Application form printed last month (page 78), add the following special information required for these countries and locations.

France, Guadeloupe, Martinique, St. Martin, Mayotte, St. Pierre et Miquelon, Reunion, French Guiana: These have reciprocal agreements with Canada and the US. Send three copies of request *registered airmail at least 60 days before arrival in France—earlier for the overseas locations* to **CGRP, BP 75, 94002 Creteil Cedex, France.** Send an international money order for 70 French Francs (for a 3-month permit) made out to **Chef de Centre de Compatibilite des Telecommunications de Reseaux Exterieurs (Postal no. 9041 99 F., Paris, France)** Enclose with your application a photocopy of the money order receipt. In addition to the information of the Universal form, give (1) Names of father and mother, (2) List your residential addresses for the last 10 years, (3) List "professions exercised" over the last ten years, and (4) Send photocopies of both operator certificate and station license.

Portugal: Under reciprocity rules the permit will be for 30 days, renewable for another 30 days. The fee is US$20 and should be sent to **Rep–Rede dos Emissores Portugueses, Rua D Pedro, V, 7–4, 1200 Lisboa, Portugal.** Special info: send father's and mother's names and state your profession. Your permit (license) must be picked up personally at the **CTT (Correos, Telephone and Telegraph) office in downtown Funchal, Rua Conde Redondo, 79, 1189 Lisboa Codex.** The ARRL says hams have had success going to that second address personally, doing the paperwork, paying the fee, and returning the next day for the license.

Spain, Islas Baleares, Islas Canarias, Ceuta o Melilla: Write the **Ministerio de Transportes y Comunicaciones, Direccion General de Correos, Subdireccion General de Telecomunicacion, Seccion de Contratacion y Autorizaciones, Plaza de Cibeles, Madrid 14, Spain,** with a self-addressed envelope, at least 3 months before your planned arrival, with a postal order for Pesetas 1600 made out to **Jefe de los Servicios de Telecomunicaciones de Madrid,** *on which you must write your callsign*. If you are going to use an EA's QTH, give his(her) callsign and indicate that individual's willingness to have you do so. Specify that you are requesting a temporary license (which is good for one year).

DOWN UNDER DX GUIDE

The Australian Radio DX Club offers an excellent publication for new DXers, *An Introduction to Amateur Radio DXing*. The 24-page guide covers every major topic that new hams and shortwave listeners (SWLs) may find confusing about DXing on the ham bands. The booklet discusses various communications modes, operating techniques, nets, logs, QSLing, and awards. It also recommends sources for other information on DXing both in and outside of Australia. The guide is available for 10 IRCs (International Reply Coupons), which includes the cost of airmail postage to the US.

The Australian Radio DX Club features a number of useful membership services, including SWL books, reporting guides in French, Spanish, and Indonesian, log sheets, and band charts. Anyone interested in Down Under DXing should contact the club at 60 Richardson Road, Croydon, Victoria, 3136 Australia.

G'day and good DXing!—NA5E

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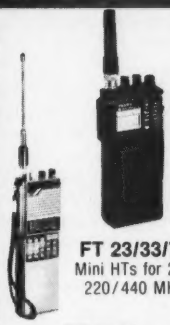

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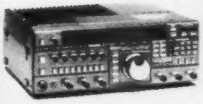

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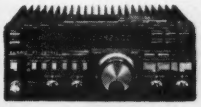

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the delegates with valid ham licenses...I [have been] working on a long book since the 1960s about the history of radio amateurs. It is almost finished."

Belgium. From May, 1987, to the end of November 1988, ON4RIP (Rest in Peace) will be on the air, operated by hams from Radioclub Ypres and also from elsewhere in Belgium, France, Germany, and the U.S. The occasion: commemoration of the more than 600,000 who died 70 years ago in the 3rd battle in the Ypres Salient Fields. A special award, the Requiem Award, will be issued for a contact with ON4RIP (SWLs eligible). Send 10 IRCs, US$7, 5 British pounds, 300 BF, 15 FL, 15 DM, 15 SFR, or 10,000 Lira to leperse Radioclub v.z.w., PO Box 32, 8900 Ieper, Belgium.

Brazil. PY1APS writes: In April 1981, Joao Havro PY5AVR made a CQ DX call which was answered by Edmund Gorecki SP2WI from Gdynia, Poland. Joao was delighted to have the chance to ask if there were Havros still in Gdynia—his grandfather, Luis, had moved from there to Brazil but left behind a brother, Joseph, with whom he had lost touch. A week later SP2WI was able to report that there was a Henrik Havro there; he turned out to be Joseph's son—and a few months later Joao visited Gdynia and his relatives there; he had an eyeball QSO with Edmund Gorecki, who gave him a tour of the city. PY5AVR visited again this summer and was distressed to find his ham friend SP2WI seriously ill and in financial straits with medical expenses. Hams helping hams: Joao has asked his friends in many CW Brazilian Groups and elsewhere for contributions to help SP2WI, at UL Kastelanska, 1; 81412 Gdynia, Poland.

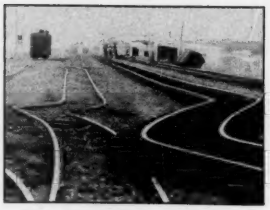
Israel. April 9, 0001–2400 UTC. Single op, SSB and CW, worldwide, Israel ARC 40th Anniversary contest on 1.8, 3.5, 7, 14, 21, 28 MHz (30 kHz from bottom of band recommended for CW). Purpose: to contact as many Israeli amateur stations with different prefixes and locations as possible. Details in the March column *if space is available! Don't count on it!*

Korea, Republic of. HL5AP sends New Year's greetings:

Edmund Gorecki SP2WI. (Photo by PY5AVR)

IARU's Region 3 Seventh General Convention will be held in conjunction with the 1988 Olympics, beginning with a Board of Director's meeting on Saturday October 8. Park Sung Bang HL1AFR, vice president of KARL, will be chairman. Opening ceremonies will be at 0930 on Monday, the 10th. That evening will be the ROK Minister of Communications' dinner. Conference sessions end Friday, the Board meets again that afternoon, the KARL dinner is that evening, and IARU Administrative Committee meetings will occupy the weekend.

New Zealand. The September, 1987, issue of *73* had the Bay of Plenty earthquake story; here is a picture. Ordinarily we would not use it since we had to reproduce it from a magazine page and that (all contributors please note!) can rarely be done satisfactorily for technical reasons. In this case, just the twisted lines tell the story. (Thanks to ZL2VR, and to *Crusader* magazine for May/June 1987.)



Sweden. SSA (Sveriges Sandareamatorer) announces two new awards, starting date January 1, 1988: W/H/ASA (Worked/Heard All Sweden) and SLA (Swedish Locator). (See Figs. 1 and 2.) The general rules are the same for both: All contacts to be made from the same QTH or within a radius of 150 km (90 miles); each contact must be on the same band and mode, but different contacts valid for other modes and bands: stickers issued for 2xCW, 2xPhone, 2xSSB, and 2xRTTY; valid as different bands are HF 1.8, 3.5, 7, 10, 14, 18, 21, 24, and 28 MHz, with separate awards for 144, 432, and 1296 MHz and Satellite. Earth repeater contacts not valid. Applicants must be members of an IARU-associated amateur radio organization. Confirmation with QSL cards or equivalent required plus a list of them in alphanumerical order. Applicants outside Sweden may have QSL cards checked by the Award Manager of the domestic national amateur radio organization and submit only a confirmed GCR list of the cards. Send to The Award Manager, SSA, Ostmarksgatan 43, S–123 42 Farsta, Sweden. WASA fee for each award: 30 Swedish kroner, US$5, or 10 IRCs.

SLA: Available to SWLs also; locators according to the new Maidenhead World Locator System (324 Fields, each having 100 locator squares—designations consist of two letters and two numbers, like JO89, which is SM0 COP's locator). The basic award is for 25 Swedish locators; stickers issued for 35, 45, 55, 60, and all 64. Award fee: 30 kroner, US$5, or 10 IRCs; stickers are 5 kroner, US$1, or 2 IRCs each. Mail as above.

Continued on page 99

Call Area	Laen	Code for laen
1	Gotland Island	I
2	Norrbotten	BD
	Vasterbotten	AC
3	Jamtland	Z
	Vasternorrland	Y
	Gavleborg	X
4	Kopparberg	W
	Orebro	T
	Varmland	S
5	Vastmanland	U
	Ostergotland	E
	Sodermanland	D
	Uppsala	C
6	Skaraborg	R
	Alvsborg	P
	Boteborg and Bohus	O
	Halland	N
7	Malmohus	M
	Kristianstad	L
	Blekinge	K
	Kalmar	H
	Kronoberg	G
	Jonkoping	F
0, 5	Stockholms laen	B
	Stockholm City	A

Fig. 1.

Class	Europeans	Non-Europeans
3	All Swedish laens on two different bands	All eight call areas
2	All laens on three different bands	All laens
1	All laens on four different bands	All laens on two different bands
Plaque	All laens on five different bands	All laens on five different bands

Fig. 2. Requirements for WASA.

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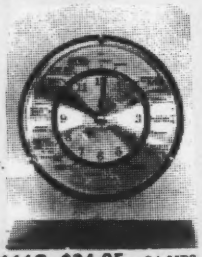

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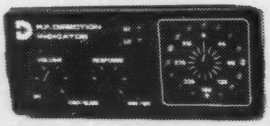

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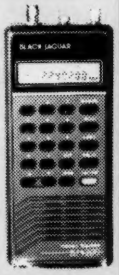

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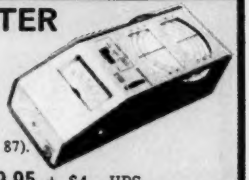

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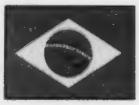
CIRCLE 43 ON READER SERVICE CARD

73 INTERNATIONAL

from page 96



BRAZIL

Carlos Vianna Carneiro PY1CC
Afonso Pena, 49/701
20270–Rio de Janeiro
Brazil

[The following information about the Abrolhos Archipelago "for, I hope, the January issue," was doomed to appear no earlier than this month even before it was mailed, on November 16. Yes, it frustrates us, too, but a basic deadline requires receipt of material on the first of a month for the issue dated two months away—the first of November for the January issue. (Brief, important, news sometimes can still make it if received two weeks late.) Since PY1CC's Fernando de Noronha's article had to be held until this issue, we are giving just barebones facts from his just-received article and are asking him instead to give us an after-the-event report later—Ed.]

DXpeditions to Abrolhos Archipelago (SA-19 in the Islands-On-The-Air—the IOTA—Directory of Islands) are so rare I don't even remember the last time amateurs operated from there. Now Donald Cutrin PY1WO is taking a group there early in January to stay until the 24th, and also taking an electronics technician, Carl PY1CC. The call will almost surely have the 6EMM suffix with special prefix. On CW, the 020 frequencies will be tried, with up or down split frequencies if pileups occur. SSB mode as usual, 3.800, 7.080, 14.195, 21.195, and 28.510 kHz, with split operation, 5 up or down. So IOTA Awards hunters and World Prefix hunters be alert! QSL manager, PY1EMM, Avenue Brasil 9020, CEP 21030, Rio de Janeiro, R.J., Brazil.

• • • • •

FERNANDO DE NORONHA

Steve NN7X/PY1ZBH mixed fun with pleasure by operating with the special callsign ZY0ZZB while on holiday in Fernando de Noronha ((PY0F) from July 1 to 10.

Peter VE3PHH was to have gone with Steve but had to cancel out for business reasons—a pity because Peter would have brought another rig and antenna from Canada. Steve, operating on all bands and only a few hours each day, made 1,521 CW and SSB contacts and worked 112 DXCC countries. The island's many attractions were such that he spent more time on the beaches and in general sightseeing than operating.

The homemade G5RV multiband antenna and telescoping pole extended to 10 meters.

F.N., a tiny archipelago belonging to Brazil, is only 4 degrees south of the equator in the South Atlantic, some 450 km off Brazil's northeast coast. Perhaps because of this close proximity to the equator, propagation was decidedly weird. In the mornings and early afternoon it was essentially one-way. Steve could hear many stations but could not work them, nor were his many CQs answered. Later in the afternoon, good signal reports were generally obtained from Europe, Africa, and the Americas, and pileups occurred.

Interestingly, there was absolutely no propagation to the Pacific, East and South Asia, and Oceania on any band at any time. There was very little to W6- and W7lands and Western Canada. Also, there was never any propagation on 160 meters although Steve had 160 capability and tried repeatedly.

His rig was an ICOM 735 running 50 to 100 Watts, a Hy-Gain 14AVQ vertical supplied by Hank N6HJ, and a G5RV multiband wire antenna which Steve made up in Rio de Janeiro just before going to the island. There are no trees or other supports available, so the G5RV was put into an inverted-vee configuration hoisted on a homemade aluminum pole telescoped to a 10-meter center height.

ZY0ZZB and the 14AVQ vertical on Fernando de Noronha.

Steve said the success of his operation was due to the outstanding assistance of the Brazilian amateur radio community, and gave special thanks to Armando PY1ECL, Ron PY1BVY, and Vasco PY0FG.

CHILE

Patricio Fernandez H. CE3GN
Casilla 14781
Santiago
Chile

[CE3GN was one of our contributors to the first International section in April, 1983. DXCC twice (the second in RTTY), he is an active member of the Radio Club de Chile, surely one of the first to be formed (in 1922).—Ed.]

I would like to draw your attention to the ever-increasing problem of interference by nonlicensed stations. Being an avid DX chaser, most of my radio operation time is devoted to listening in between 14.070 and 14.100. It is not rare to find amateur phone stations in this segment of the 20-meter band who, by ignorance and/or plain convenience, carry out conversations, possibly thinking that it is an excellent hideout or that nobody is listening to them. All the stations I have heard have been Latin American, and in most cases just a few convincing words of warning have been sufficient for them to QSY to above 14.100.

This type of interference is not the real problem, however. The real and incredible interference situation is carried out by non-amateur, nonlicensed, totally pirate stations that are operating on this segment of the band. Throughout the past 12 months I have been patiently monitoring a couple of stations that appear daily at around 14.091 on USB phone. The language is Spanish, and by their accent I am positive they are not CE, LU, or OA. As the transmission comes from the north, and considering propagation and time, I have no doubt they must be situated around HK- or YVland, with a slight chance of being HC or CP.

I have monitored the same stations (same voices) almost every day at around 2300Z to 0200Z. Earlier than that I am at work, so no monitoring by me has been made at other times when they might also be active. Their topics of conversation are strictly commercial and very obscure. I would not be surprised at all if it were related to narcotraffic. Every time I have attempted to chase them away, they have answered back with extremely obscene language and have ignored my warnings. The few times I have been successful in making them QSY—with some convincing bursts of RYRYRY from my RTTY transmission—they have limited their shift to a few kHz up or down and have continued their illegal operation. They have never given a callsign of any sort, and their usual calling procedure is by a certain type of whistling on the microphone.

The reason for telling you of my experience is that I am convinced many of you who usually operate RTTY on 20 meters have heard this illegal activity, and if we exchange information we may rapidly be able to locate these stations—or at least find out more about them. In that event we could inform the local authorities of the country(ies) involved so that they could do something about the situation.

If any of you readers feel you have information please let me know as soon as possible so that I may coordinate some action and, hopefully, get rid of these disgusting intruders.

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Drive frequency is continuously monitored by the processor and adjustments made to ensure maximum amplifier output at all times. As you talk, the amplifier's tuning is constantly adjusted as required. Powerful gearhead motors drive the bandswitch, tuning, and loading capacitors.

High Quality. The 230A is manufactured to the same standards as the 230C, the commercial/military version.

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Remote RF/power supply deck is not shown.

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Frequency. All amateur bands from 1.8 to 21 Mhz (to 30 Mhz for export).

Drive. 50-80 watts for full power.

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Input Power. 220-250 VAC, 50Hz, 20 amperes max.

Dimensions. Microcontroller: 10" wide x 6" high x 9" deep. RF/power supply deck: 14" wide x 22" high x 13" deep.

All interconnect cables are furnished for ease of set up. In addition to the above, the 230C provides continuous frequency coverage from 1.8 to 30 Mhz with a no time output rating of 2250 watts PEP. Three 3CX800A7's are utilized.

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CIRCLE 10 ON READER SERVICE CARD

OP-ED

by Larry Ledlow, Jr. NA5E

A Brief Look Ahead

A reader called me the other day to say how glad he was "to see *73* had finally entered the 1980s." Editors always like to hear good things about their magazines, and I am no different. There's something special about a stroke of the ego. Constructive criticism serves a good purpose, but a compliment always seems to make worthwhile the long hours and sheer madness in the rush towards deadline.

73 has entered the 1980s, all right, and we're headed for the next decade—nay, the next century—PDQ! It's one thing to be up to date, but it's quite another to look ahead, to set goals, to plan, and finally to take steps toward those goals. My motto for the magazine: Communications techniques and technology for today *and* tomorrow.

Taking a look at feedback cards and talking to subscribers at the hamfests, it's very easy to conclude the majority of our readers are insightful, technology-oriented, and like to keep informed. Newcomers to the hobby pick up *73* because of our friendly approach. No doubt about it, readers turn to *73* as a modern, practical and useful information source. They've grown tired of silent key lists, DXCC certification debates, and endless contest announcements.

We're picking up momentum, moving ahead like no other ham magazine can, because the readers want it that way. We'll take you to the future. We're excited about the future. Let's take a brief look at just a few things that will happen in the next several years.

WARC 1991

Wonderful days lie ahead. Before long we can all bask in the warmth of increased sunspot numbers and better propagation. Just think, 20 meters will be open 24 hours a day, and a light breath on the mike will snag a contact. Great! Take advantage of it while you can, because the next sunspot cycle peak may come along when ham radio is all but dead on HF. . . unless we start planning right now.

I'm pretty optimistic and upbeat about the future of ham radio. At the same time, let's take a look at some major forces that threaten the HF ham bands.

International shortwave broadcasting is *big* business. Just scan across 6, 9, 11, or 15 MHz some day with that general coverage capability built into your transceiver. Wall to wall signals, right? Whether for God's word, the Communist Manifesto, or Quechua Christmas carols, millions of people the world over listen to international broadcasters, and the number is increasing.

You can bet the broadcasters are aware of improving band conditions. And as more and more broadcasters vie for the same frequency allocations, interference will no doubt increase. The stations received more frequencies at the last World Administrative Radio Conference (WARC) in the late 1970s, but the increase failed to satisfy today's incredible demands on HF band space.

The pressure on frequency allocations comes also from increased needs of military and commercial interests. All three HF user groups are well organized. Guess where they're going to look for more frequencies at the next WARC? You got it, the ham bands. Hams occupy some pretty favorable frequencies, like 20 and 15 meters, and unless we get organized and plan ahead, we may see a reduction in our frequency allocations!

The next WARC, probably to be held in 1990, is practically around the corner. Don't kid yourself. The broadcasters are already planning!

Upward Bound

AMSAT's Phase IV satellite in geosynchronous orbit is something else to look forward to in the early 1990s. The satellite will orbit above the same point on Earth, more than 22,000 miles above the equator, just like today's commercial communications satellites. The convenience of a geosynchronous hamsat will hopefully turn on a lot of folks to space communications. A repeater in the sky, I guess you could call it. No need to schedule QSOs around two or three 15 minute orbit "windows" each day as with low orbiters.

Increased communications activities from the Space Shuttle and the Space Station are also pending. More hams will turn their antennas skyward to converse with astronauts.

Think about it! It's just a few years away. This stuff is getting exciting!

Another Revolution

Digital technology is alive and well in commercial and military worlds. It's just about time for some pretty smart gadgets to enter amateur service. High-speed A/D converters are fairly inexpensive. Some smart signal processing software built into an EPROM could take care of a lot of QRM problems. Digital filters and synchronous signal detection are all affordable and within the realm of modern technology. We hams use some pretty basic communications methods that digital signal processing can handle without any trouble at all.

More important, it's about time we weaned ourselves from antiquated and inefficient (from a band width point of view) communications technologies. I'm glad to see a number of manufacturers—AEA and Kantronics, among others—taking advantage of modern digital techniques.

Digital is the way to go, believe me. Once you have a signal in ones and zeros, the possibilities for processing are endless! You can add, subtract, delete, multiplex, randomize, and invert ones and zeros in a split second with a tiny chip. Amazing advances, when you think about it, and it's just around the corner!

Come Along With Us

C'mon now. I've just given you three things coming up in the next few years to get pretty excited about. If you're not a techie or a space cadet, then you ought to at least get worked up over the possibility of losing frequencies.

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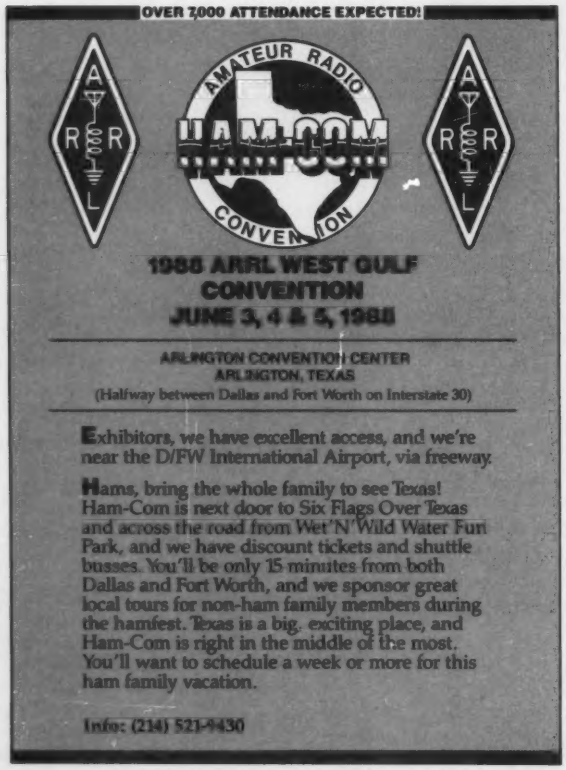
I'm ready. Are you? 73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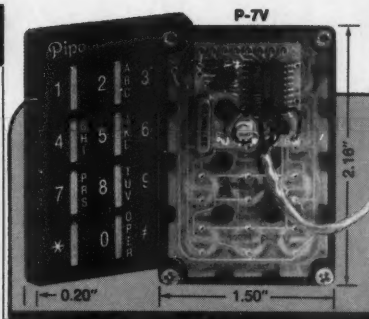

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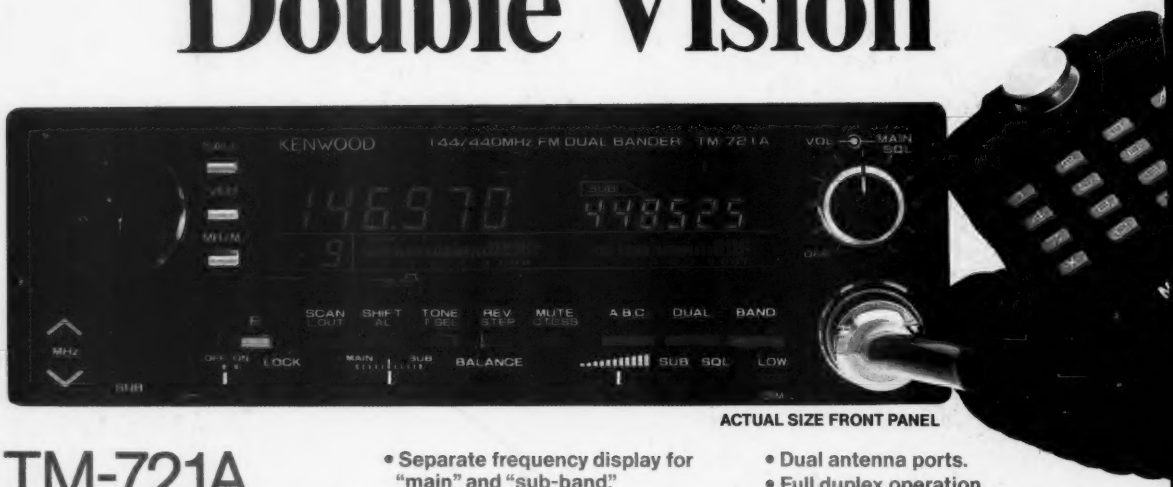

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